ILIMA COLLIERY

PROPOSED EXTENSION OF THE MINING OPERATIONS AT THE EXISTING ILIMA COLLIERY (OLD PEMBANI COLLIERY), NEAR CAROLINA, ALBERT LUTHULI LOCAL MUNICIPALITY, GERT SIBANDE DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

HERITAGE ASSESSMENT

Issue Date: 14 September 2017

Revision No.: 1

Project No.: 263HIA

PGS Heritage (Pty) Ltd
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Reg No 2003/008940/07

Declaration of Independence

I, Jessica Angel, declare that –

General declaration:

- *I act as the independent heritage 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 heritage impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, Regulations and all other applicable legislation;*
- *I will take into account, to the extent possible, the matters listed in section 38 of the NHRA 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 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;*
- *I will perform all other obligations as expected from an heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and*
- *I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.*

Disclosure of Vested Interest (delete whichever is not applicable)

- *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 Regulations;*

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd

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SIGNATURE: _____

Report Title	Proposed, extension of the mining operations at the existing Ilima colliery (old Pembani colliery), near Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.		
Control	**Name**	**Signature**	**Designation**
Author	**J Angel**		Heritage specialist
Reviewed	W Fourie		Heritage Specialist

ACKNOWLEDGEMENT OF RECEIPT

CLIENT: Earth Science Solutions

CONTACT PERSON: Ian Jones

Email: ian@earthscience.co.za

SIGNATURE: _____

EXECUTIVE SUMMARY

PGS was appointed by Earth Science Solutions to undertake an HIA that forms part of the Environmental Impact Assessment (EIA) as part of the proposed extension of the mining operations at the existing Ilima colliery (old Pembani colliery), near Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

The HSR completed as part of the HIA process has shown that the proposed LCPP may have heritage resources present in the study area. This has been confirmed through archival research and evaluation of aerial photography and topographical maps of the sites.

Evaluation of aerial photography has indicated the following area that may be sensitive from a heritage perspective.

These findings provided the basis for the recommendation of further field truthing through a heritage field study and palaeontological desktop study covering the site.

During the field assessment, a total of 23 heritage sites were located. These include 5 cemeteries (**ILM001**, **ILM002**, **ILM008**, **ILM010**, and which have fencing or berms enclosing them, 3 historic grave sites (**ZV02, ILM006** and **ILM011** unprotected), 4 informal cemeteries (**ILM 012**, **ILM013**, **ILM017** and **ILM018** unprotected), 2 possible graves (**ILM009** and **ILM016**), 9 structures **ILM003**, **ILM004**, **ILM007**, **ILM014**, **ILM015, ZV04-07** and one possible site of mining infrastructure **ILM005**.

The management and mitigation measures as described in Section 7 of this report have been developed to minimise the project impact on heritage resources.

It is my considered opinion that overall impact on heritage resources after the implementation of the recommended mitigation measures is acceptably low and that the project can be approved from a heritage perspective.

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Terminology and Abbreviations

Archaeological resources

This includes:

i. material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation; wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;

iii. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Burial Ground

A place containing one or many graves.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;

ii. carrying out any works on or over or under a place;

iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;

iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

ABBREVIATIONS	DESCRIPTION
ASAPA	Association of South African Professional Archaeologists
DEA	Department of Environmental Affairs
EAP	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
ESS	Earth Science Solutions
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PGS	PGS Heritage (Pty) Ltd
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

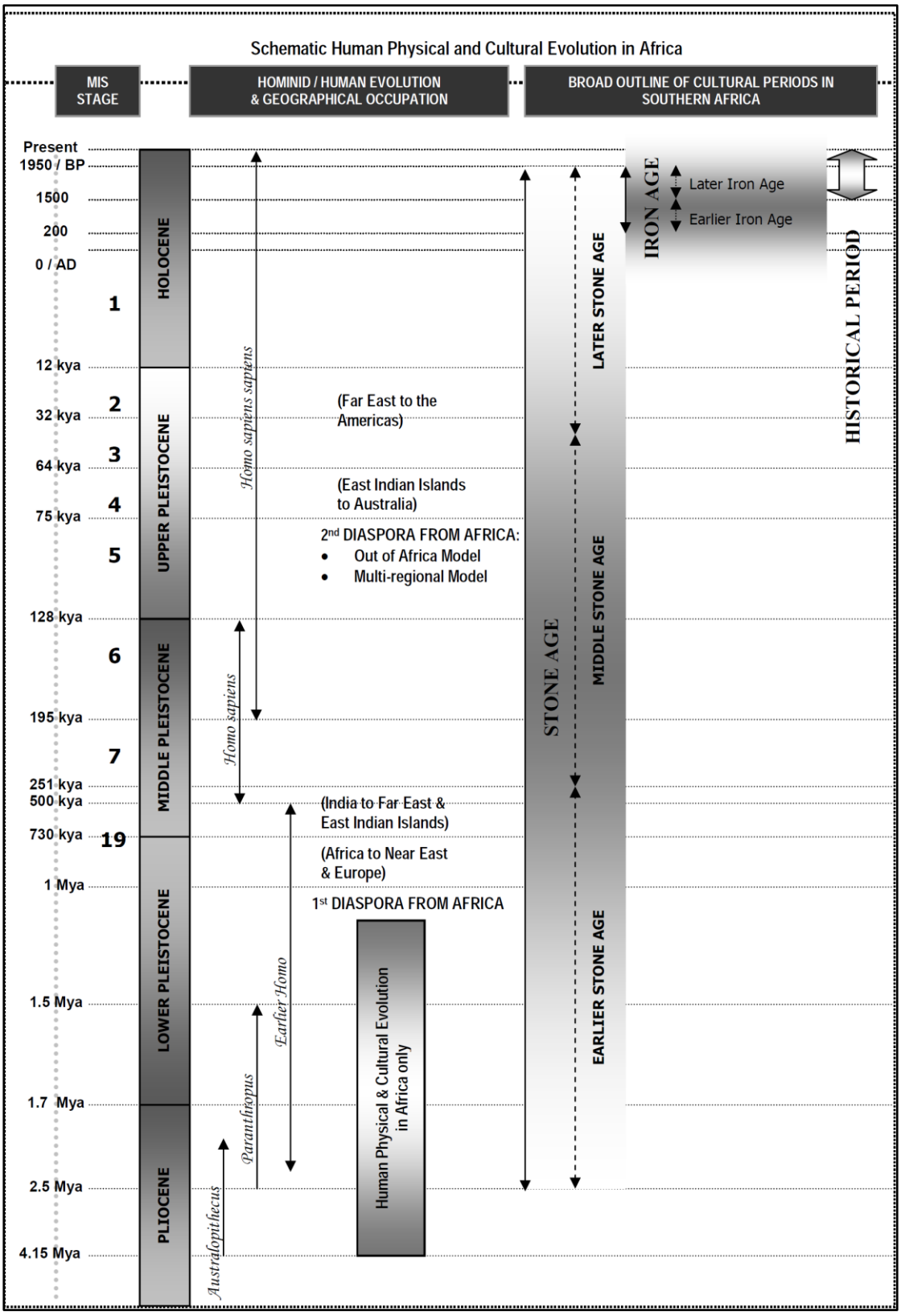

Figure 1 – Human and Cultural Time line in Africa (Morris, 2008)

1 INTRODUCTION

PGS Heritage (Pty) Ltd was appointed by Earth Science Solutions hereafter referred to as ESS, to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) as part of the proposed extension of the mining operations at the existing Ilima Colliery (old Pembani colliery), near Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage resources and finds that may occur in the proposed development area. The HIA aims to inform the EIA in the development of a comprehensive EMPr to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA was compiled by PGS Heritage (PGS).

The staff at PGS has a combined experience of nearly 40 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Jessica Angel, the heritage specialist and author, holds a Masters degree in Archaeology and is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA).

Wouter Fourie, the Project Coordinator, is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover in some areas.

As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time as the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development the procedures and requirements pertaining to graves and burials will apply as set out below.

Although the total application area covers nearly 18 000 ha, the HIA focussed on the directly impacted mining areas of approximately 700ha. **Figure 2** shows the areas assessed during the fieldwork.

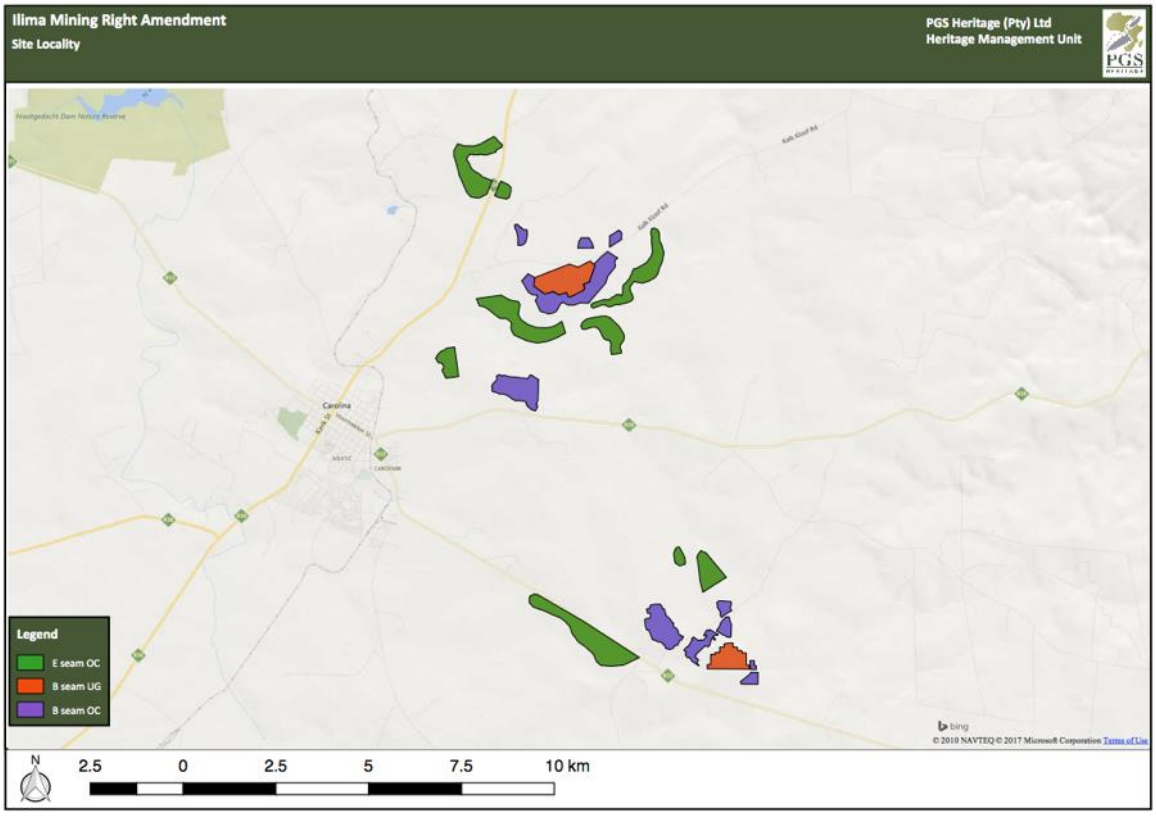

Figure 2 – Surface impact areas visited during the heritage fieldwork

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998
ii. National Heritage Resources Act (NHRA), Act 25 of 1999
iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
    d. Environmental Management Plan (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage Resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, "…*identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

1.5 Heritage Significance Grading

Heritage Site significance classification standards prescribed by the SAHRA (2006) and approved by the ASAPA for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 1 - Site significance classification standards as prescribed by SAHRA.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	-	Low Significance	Destruction

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location

The Ilima Colliery covers approximately 17 776 hectares (ha). **Table 2** below indicates the farm portions that fall within the Mining Right Area and includes the Mining Right Application Area, as well as the properties for which Ilima is amending its EIR (refer **Figure 3** below for a locality map).

Table 2: Locality Details

Farm Name	Mining Right holder Ilima Coal Company (Pty) Ltd. is the holder of a Mining Right in respect of the following properties within the existing Ilima Colliery: Appeldoorn 38 IT Remaining Extent (RE); Portion 9 and Portion 10; Groenvallei 40 IT Remaining Extent (RE) of Portion 1; RE of Portion 7; (RE) of Portion 8; (RE) of Portion 11; Portion 12; Portion 13; Portion 14 Portion 15; Portion 16; Portion 17 and Portion 19. Haarlem 39 IT Remaining Extent (RE); Portion 2; Portion 3; Portion 4 and Portion 5. Hawerfontein 7 IT Remaining Extent (RE) of Portion 1; Portion2; Portion 3; Portion 4; Portion 5; Portion 6; Portion 7; Portion 8; Portion 9; Portion 10 and Portion 13. Kwaggafontein 8 IT Remaining Extent (RE) of Portion 6; (RE) of Portion 7; Portion 8; Portion 9; Portion 10; and Portion 11. Leeuwpoort 13 IT Remaining Extent (RE); Paardeplaats 12 IT Remaining Extent (RE); Portion 2; Portion 4; Portion 5; Portion 6; Portion 10; Portion 11; Portion 12 and Portion 13. Twyfelaar 11 IT Portion 3; Portion4; Portion 6; Portion 11; Portion 12 and Portion 13; RE of Portion 5 and RE of Portion 8. and Zandvoort 10 IT Remaining Extent (RE); and Portion 1.
Mining Right Area (Ha)	The Ilima Colliery Mining Rights covers approximately 17 302 ha.
Magisterial District	Magisterial District of Carolina
Distance and direction from nearest town	The Ilima Coilliery is situated east of Carolina, immediately north of the R38, in the Mpumalanga Province, South Africa. The Ilima Colliery is situated in the magisterial district of Carolina and falls under the Chief Albert Luthuli Local Municipality, situated in the Gert Sibande District Municipality. The closest town to the mining area is Carolina, situated approximately 3 km to the West of the proposed mining sites.

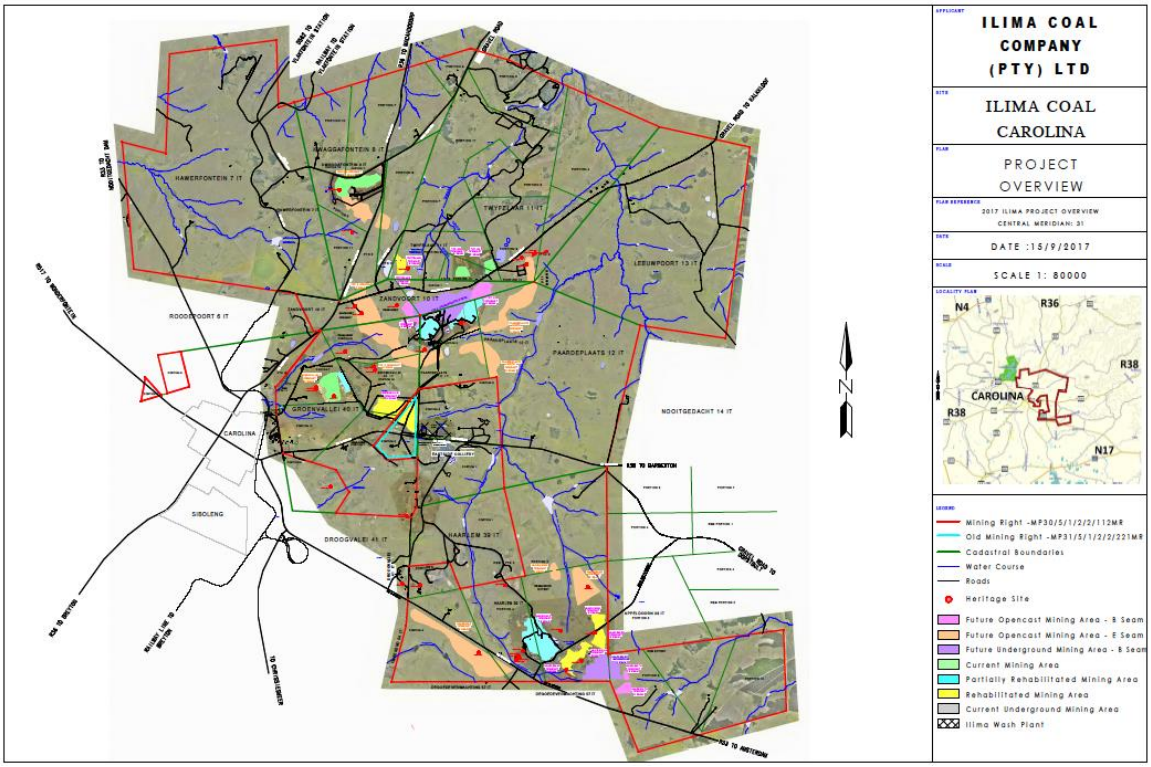

Figure 3 - Locality Map of the Ilima Colliery

2.2 Project description

The Ilima Colliery is an existing mine which has been in operation for several years. As such the construction of the majority of the mine infrastructure has been completed, including mine offices, a wash plant, workshop facilities, dirty water containment facilities, etc. Extensive opencast mining has also taken place, although the mine has only recently commenced with underground mining. Due to the large area under the mining right, the mining activities (opencast and underground) have and will be approached as a phased development over the LoM (30 years).

2.2.1 Mining Operations

Below is a description of the mining operations including the mineral resource and the mining methods for Ilima.

2.2.2 The Mineral Resource

The Ilima Colliery is situated within the northern part of the Ermelo Coalfield, which forms part of the coal-bearing Vryheid Formation of the Ecca Group. The Ecca Group forms part of the larger Karoo Super group. The coal seams present, within the Ermelo Coalfield, are named from the base to the top, E to A. In the northern parts of the coal field the E Seam attains a thickness of over 3m

and consists of mainly bright coal and ranges from the surface to about 100 m. The less prominent D Seam (< 0.6 m) is usually too thin to be of economic value although being predominantly bright coal and ranges from surface to about 70 m. The C Seam is usually sub-divided into the C Upper and the C Lower due to several plies that vary in thickness. The C Lower is usually thin and seldom thicker than 0.6 m however thickens towards the Dirkiesdorp District reaching thicknesses of up to 3 m. In contrast to the other seams the C Upper is well developed in the entire coal field but is of poor quality and tends to be torbanitic over large areas. Thicknesses usually vary from 0.4 m – 4 m depending on the area. The B Seam is usually split into the B, B1, and BX however in the Ermelo district only the B (Lower) and the BX (Upper) are considered feasible for mining. The B Seam may reach thicknesses of up to 3 m and consists of mainly dull coal (high sulphur content), capped by a glauconitic sandstone. The A Seam is of moderate to low quality across the coal field and occurs as outliers in the central and northern parts of the coal field (Greenshields, 1986).
The B Seam and the E Seam are the main economic coal seams present within the mining area and these are exploited by means of opencast and underground mining operations. The average depth of the E seam is 53 m and 27.6 m for the B seam.

2.2.3 Mining Method to be Employed

The Ilima Colliery has access to extensive coal reserves which are to be exploited by both above ground (opencast mining) and below ground mining methods (bord and pillar underground mining). Extensive opencast mining has also taken place, although the mine has only recently commenced with underground mining. The mining methods that will be employed in the future are discussed in the sections that follow.

2.2.3.1 Opencast Mining

Opencast mining will be undertaken in the form of strip mining where the strips are laid out to follow the surface contours. As the strips progress, the previous pit is rehabilitated, thus resulting in minimal surface disturbance (i.e.: role over mining method). The coal is transported by truck to the existing Imbani Wash Plant where wet processing of the coal will take place. Certain temporary infrastructure associated with the opencast mining activities (such as storm water management infrastructure) will move as the opencast mining progresses along the coal seams to the new pit areas.

2.2.3.2 Underground Mining

Further to the opencast, mining the remainder of the deeper coal reserves will be mined using the bord and pillar underground mining method. The entire infrastructure will be situated around the entrance to the underground workings (either box-cut or highwall). The entire area at each underground operation within the security fence will cover less than 20 ha. The underground infrastructure shall typically include the following:

- Ventilation fans
- Short Conveyors (bringing coal to surface)
- ROM stockpiles;
- Substation;
- Parking Area;
- Lamp Room;
- Stores;
- Cable Shop;
- Workshop;
- Washbay;
- Refueling Bay;
- Stone Dust Shed;
- 10m x 10m sump;
- Service Water Dams;
- Potable Water Dam.

Coal will be transported to the surface via conveyor for temporary storage at the RoM stockpile. All coal will either be directly transported by means of coal trucks to the processing plant or will be crushed by means of a mobile crusher and directly sold to Eskom and/or other clients from pre-qualified stockpiles situated near the underground access.

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This HIA report was compiled by PGS for the proposed extension of the mining operations at the existing Ilima colliery (old Pembani colliery). The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by a qualified archaeologist (4-8 September 2017), aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of heritage sites was based on four main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m2
    - Medium - 10-50/50m2
    - High - >50/50m2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site.

Impacts on these sites by the development will be evaluated as follows:

3.2 Site Significance

Site significance classification standards prescribed by the SAHRA (2006) and approved by the ASAPA for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 3: Site significance classification standards as prescribed by SAHRA.

Field Rating	Grade	Significance	Recommended Mitigation
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	-	Low Significance	Destruction

3.3 Methodology for Impact Assessment

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall

significance (S). Please note that the impact assessment must apply to the identified Sub Station alternatives as well as the identified Transmission line routes.

3.3.1 Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C = \frac{(E + D + M + R)x\ N}{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 4**.

Table 4: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).

Aspect	Score	Definition
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per **Table** 5**.**

Table 5: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$\mathbf{ER = C \times P}$$

Table 6: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table** 7.

Table 7: Significance Classes

Environmental Risk Score	
Value	**Description**
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

3.3.2 Impact Prioritisation:

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of Cumulative impacts and the degree to which the impact may cause irreplaceable loss of resources.

In addition, it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision making process.
In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 8: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 11. The impact priority is therefore determined as follows:

$$\mathbf{Priority} = \mathbf{PR} + \mathbf{CI} + \mathbf{LR}$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to **Table 9**).

Table 9: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 10: Final Environmental Significance Rating

Environmental Significance Rating	
Value	**Description**
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

4 BACKGROUND STUDY

4.1 Archival findings

The high level archival research focused on available information sources that were used to compile a general background history of the study area and surrounds.

4.2 Archival/historical maps

Historical topographic maps were available for utilisation in the study:

Topographical map 2630AA – First edition 1968. The aerial photography on which the map was based dates to 1956 and its survey work was undertaken in 1968. It was drawn in 1969 by the Trigonometrical Survey Office.

4.3 Topographical Maps 2630AA (First Edition)

The map was utilised to identify structures that could possibly be older than 60 years and thus protected under Section 34 and 35 of the NHRA. Seven structures are identified in the overall area. These features consist of “huts” and sheds (**Figure 4**).

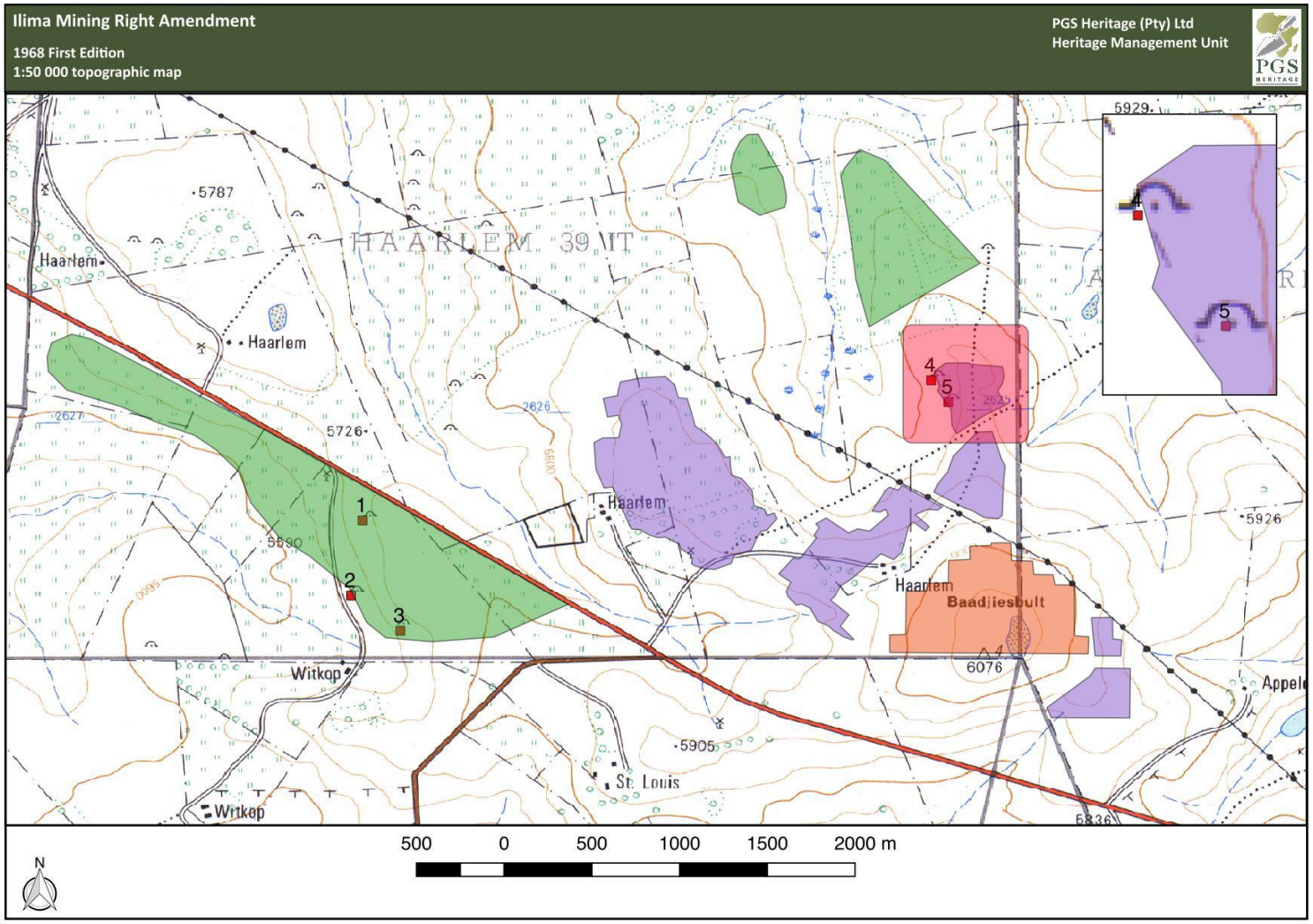

Figure 4 - 1969 Topographic Map showing heritage features present within the southern parts of the study area.

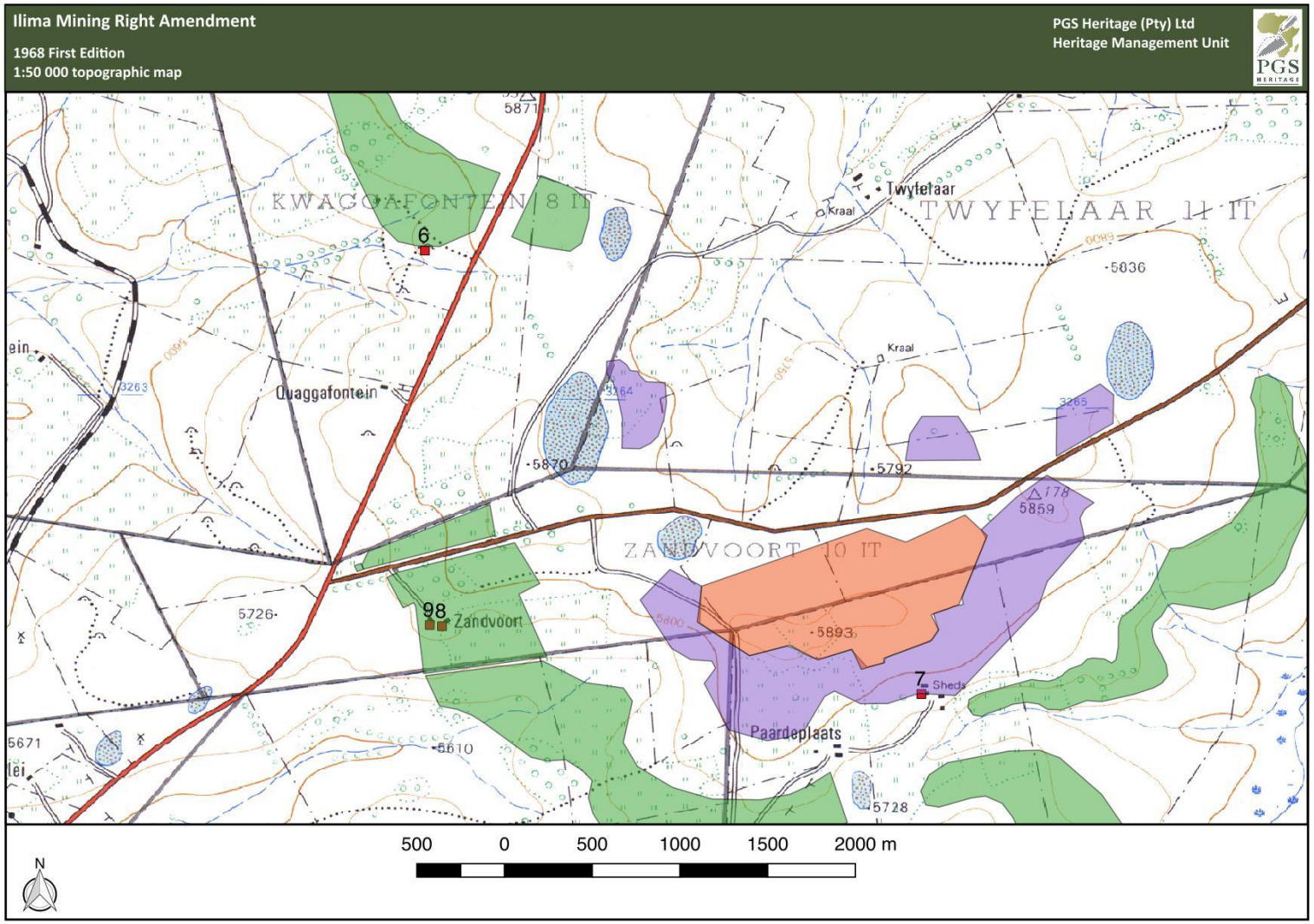

Figure 5 – 1969 Topographic Map showing heritage features present within the northern parts of the study area

4.4 Aspects of the area's history

4.5 Previous Heritage Studies in area

A search on the South African Heritage Resources Information System (SAHRIS) has identified Heritage Impact Assessments conducted in and around the study area:

- A Heritage Impact Assessment (HIA) study for the proposed New Optimum Colliery on the farm Schoonoord 164IS in the Mpumalanga Province of South Africa - Pistorius, J. C. C. (2004), this assessment located historical structures, graveyards, and remains dating from the relatively recent past.

- Imbani Coal Heritage Scoping on Various Portions of Farms in the Carolina District, Mpumalanga – Fourie, W. (2006), This assessment located cemeteries and informal graves, historic structures and iron ages structures

- Heritage Impact Scoping Report for the Planned Hendrina-Marathon Power line, Mpumalanga Province – J van Schalkwyk (2007)

- AIA Northern Coal Portion 15 and 16 of the farm Weltevreden 381 JT, Belfast, Mpumalanga- Fourie, W (2008). This assessment located no heritage features.

- Arnot Colliery Mine Project of Exxaro On Portions 4 and 5 of the farm Mooifontein 448 JS and Portions 3 And 4 of the farm Tweefontein 458 JS , District Middelburg, Mpumalanga -Fourie, W (2009). This assessment located 7 cemeteries, one occupied homestead with associated infrastructure dating between 1900 and 1930 and three homestead remains

- Phase 1 Archaeological Impact Assessment for Enpact Environmental Consultants concerning the proposed Elandshoek township development on portions 2 and 6 of the farm Lindenau 303 JT and portion 2 of Berlin 466 JT, Mpumalanga Province – JP Cilliers (2010) this assessment located, two cemeteries, a Black Concentration Camp, and the existence of war graves.

- A report on a heritage assessment for the proposed Arnot-Gumeni 400 kv powerline project, in the Middelburg/Belfast area, Mpumalanga Province – Pelser, A.(2012). This

assessment located stone walled Iron Age sites, possible Stone Age sites, historical homesteads/farmsteads, historical Anglo-Boer War (1899-1902) battlefield sites and others, as well as graveyards and cemeteries.

- Exxaro Paardeplaats Project Heritage Impact Assessment Report – Kitto, J (2012) this assessment located, 22 heritage structures, 7 cemeteries and 3 areas with historical mining shafts

- A phase I Heritage Impact Assessment (HIA) study for the consolidated Environmental Management Programme report (consolidated EMPR) for Arnot Coal on the eastern highveld in the Mpumalanga Province - - Pistorius, J. C. C. (2014) this assessment located Historical farmstead complexes consisting of various structures, Individual historical structures such as houses, wagon sheds, rondavels, etc. and graveyards and graves, some of which can be classified as historical as they are older than sixty years.

- Proposed expansion of existing mining area into portion re of the farm Roetz 210 IS, Jagtlust Colliery, near Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province – Kitto, J (2015) this assessment located Historical structures and graves.

- A revised phase I Heritage Impact Assessment (HIA) study for the proposed Rietvlei open cast coal mining operation between Middelburg, Belfast and Stofberg in the Mpumalanga province of South Africa. - Pistorius, J. C. C. (2014) This assessment located 5 graveyards

- Pembani coal mine. Proposed underground mining on the farm Zandvoot 10 IT, near Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. – Birkholtz, P. (2015). This assessment located historic structures, a historic cemetery and an informal grave.

- Heritage Assessment - The Kwagga North Project, Optimum Coal, Arnot, Mpumalanga – Fourie, W (2016), this assessment located 29 cemeteries with a total of approximately 350 graves, 6 farmsteads and one quarry site.

4.6 Archaeological Background

The province of Mpumalanga is known to be rich in archaeological sites that tell the story of humans and their predecessors in the region going back some 1,7 million years (Delius & Hay, 2009). The pre-colonial period is divided broadly into the Stone Age and the Iron Age *(Refer to* **Figure 1** *for a visual representation of the human time line).*

The Stone Age refers to the earliest people of South Africa who relied mainly on stone for their tools and were hunter-gatherers. This period is divided into the Earlier, Middle and Later Stone Age:

- *Earlier Stone Age:* The period from ± 2.5 million yrs. - ± 250 000 yrs. ago. Acheulean stone tools are dominant.
- *Middle Stone Age*: Various stone tool industries in SA dating from ± 250 000 yrs. – 40 000 yrs. before present.
- *Later Stone Age:* The period from ± 40 000 yrs. before present to the period of contact with either Iron Age farmers or European colonists. (Delius & Hay, 2009; Morris, 2008)

The Iron Age as a whole represents the spread of Bantu speaking people whose way of life was pastoral-agricultural and includes both the Pre-Historic and Historic periods. As indicated by the name, this period is distinguished by the knowledge of extraction and use of various metals, mainly iron. Similarly to the Stone Age, it can also be divided into three periods:

- *The Early Iron Age:* Most of the first millennium AD.
- *The Middle Iron Age*: 10th to 13th centuries AD
- *The Late Iron Age:* 14th century to colonial period. (Delius & Hay, 2009; Morris, 2008)

The archaeological literature does not contain much information on the Stone Age archaeology of this area, since this period has not been researched extensively in Mpumalanga (Esterhuysen & Smith, 2007). However, it is clear from the general archaeological record that the larger Mpumalanga region has been inhabited by humans since Earlier Stone Age (ESA) times. Although no Stone Age sites are known from the immediate vicinity of the study area, there are some sites recorded in the greater region (Esterhuysen & Smith, 2007). Examples of such sites are noted below.

4.6.1 Stone Age Sites

An Earlier Stone Age site is located at Maleoskop near Groblersdal. Concentrations of ESA stone tools were found in erosion gullies along the Rietspruit (Esterhuysen & Smith, 2007). Evidence for the Middle Stone Age (MSA) period has been excavated from Bushman Rock Shelter, situated on the farm Klipfonteinhoek in the Ohrigstad District. The MSA layers indicated that the cave was visited repeatedly over a long period, between approximately 40 000 years ago and 27.000 Before Present (Esterhuysen & Smith, 2007). Two Later Stone Age (LSA) sites were found at the farm Honingklip near Badplaas in the Carolina District, (Esterhuysen & Smith, 2007).

4.6.2 Iron Age Sites

Early Iron Age

Early farming communities moved into the Mpumalanga area around AD 500. These early farmers used metal tools and pottery and lived in fairly permanent agricultural villages. The most well-known EIA site in the area is the Lydenburg Heads site in the Sterkstroom Valley. A brief account of the discovery is provided by Esterhuysen and Smith (2007) (**Figure 6**):

In 1957 a young boy, Ludwig von Bezing, found some strangely shaped pieces of pottery on his father's farm near Lydenburg, which seemed like pieces of human masks. Over the next few years he collected more fragments as well as other artefacts, including pot shards, iron and copper beads, ostrich eggshell beads, and millstones. Whilst studying at the University of Cape Town, he brought the fragments to the attention of Ray Inskeep, professor of archaeology. Inskeep then excavated the site and supervised the masks' reconstruction. Known as the Lydenburg Heads, they immediately became famous, partly because of their rarity and intriguing appearance, and partly because they reveal aspects of past cultural and ritual practices. They are on permanent display at the South African Museum in Cape Town. The heads have been carbon-dated to about AD 500. Similar pottery heads dating to the same period have been found near the KwaZulu-Natal coast.

Figure 6 - Lydenburg Heads (Iziko Museum; from Delius, 2009)

Later Iron Age

Late Farmer societies developed extensive stone settlements around Lydenburg, Badfontein, Sekhukhuneland, Roossenekal and Steelpoort (Delius & Hay, 2009). The greater Belfast area specifically, is known for its large complexes of LIA stonewalling. Although there was some early research on the stone ruins in the general region of the then-named eastern Transvaal, systematic investigation of the ruins only began in the last decade (Collett, 1982). Evers (1975) and Mason (1968) both undertook surveys of aerial photographs of the general area and identified a vast number of such settlements between Lydenburg and Machadodorp. Evers noted that settlements are not evenly distributed over the area, largely for topographical reasons (1975). These settlements typically consisted of three interrelated elements: homesteads, with cattle kraals surrounded by enclosures for human habitation; stone-edged paths or roadways, probably for movement of cattle; and stone terraces, for agricultural cultivation. Most of the homesteads were built in symmetrical patterns, some of which were reproduced in rock engravings found close to these settlements (Delius and Hay; 2009).

With regard to dating, the beginning of the Late Iron Age in this region is obscure. At the time of Evers' article there were no sites known that were intermediate in age between the Early Iron Age sites and the later stone-walled sites. However, since elsewhere in the then-named Transvaal and Orange Free State, stone-walled building appeared to start around A.D. 1450-1500, this was thought to be true in this region as well (Evers, 1975).

Rock Engravings

An article by Maggs (1995), explains that these agriculturist engravings are mainly dominated by depictions of ground plans representing the shape of settlements people built and lived in. Virtually all known engraved sites are in the vicinity of Late Iron Age settlements and it is now known that such engravings are much more common than was previously thought. Fieldwork in several such regions has produced many formerly unrecorded sites within the limited areas searched. Therefore, Maggs recommended that future fieldwork on the stone-built settlements should incorporate an examination of neighbouring rock outcrops for possible engravings (*ibid*). Maggs' article highlights that such images may represent abstract or symbolic spatial arrangements reflecting the cosmology of the society that made them. He uses an example taken from the Pedi, a northern Sotho group linked geographically and culturally with the Mpumalanga engravings. Within this system, social and religious structure was, and among many rural communities still is, clearly inseparable. Each member literally knows their place within the homestead according to their age, sex and status (*ibid*).

4.7 The South African (Anglo-Boer) War

Delius & Hay (2009) note that the area between Belfast and Machadodorp was very active during the Anglo Boer War (1899-1902) with numerous skirmishes, railway sabotage and battle sites occurring in the Mpumalanga Highveld area. The Anglo-Boer War or South African War was waged between Great Britain and the two Boer Republics, the ZAR and the Oranje Vrystaat, from 1899 to 1902 (*ibid*). Pretoria was captured by the British on 5 June 1900, but this did not result in the end of the war, as had been anticipated. British forces then embarked upon the defeat of the Boer forces still occupying the then Eastern ZAR. Various British forces advanced towards the ridge of the eastern Highveld, (Jooste, 2001). In August 1900, it was decided by the Boer forces that the line must be defended at all costs, as Machadodorp, the temporary seat of the ZAR government (5 June 1900 – 27 August 1900), was to be protected to safeguard a retreat toward Lydenburg and Barberton (Fourie, 2008a). After the battle of Bergendal (see below), where the Boer forces were defeated; on 28 August 1900, and the town of Machadodorp was occupied by the British troops and on 1 September 1900, Lord Roberts, Commander-in-chief of the British troops in Southern Africa, proclaimed the Transvaal as part of the British Empire (Jooste, 2008).

4.7.1 Belfast and the Battle of Bergendal

The Battle of Bergendal, also known as the Battle of Belfast and the Battle of Dalmanutha, is called the "last set-piece battle of any size in the [Anglo-Boer] war" by Pakenham (1979). However, although the Boer forces were defeated and the British won the battle, Botha's main force remained intact. The commandos dispersed to Lydenburg and Barberton, and a phase of guerrilla warfare began.

This second phase of the war lasted even longer than the first. Peace would only be declared at the end of May 1902 (Jooste, 2002). Jooste (*ibid*) provides a brief summary of the Battle of Bergendal in an article in the Military History Journal of December 2002. Because Machadodorp had become the temporary seat of the ZAR government (5 June 1900 – 27 August 1900), a defensive line was set up with the central part occupied by the Zuid Afrikaansche Republiek Politie (ZARP) under command of Commandant G.M.J. van Dam on a rocky outcrop on the farm Bergendal. On 26 August 1900, the Battle of Bergendal commenced and the British forces advanced on the Boer Lines. The Boer lines were breached in certain sections but the main resistance was coming from the ZARP position. On 27 August a major offensive was concentrated on the ZARP position, with a three-hour bombardment of the ZARP kopje commencing at 11 am. The Boer defences were breached on 28 August and Buller's troops marched into Machadodorp. Five days later, on 1 September 1900, Lord Roberts proclaimed the annexation of the ZAR as the Transvaal Colony. Refer to **Figure 7** for a map of the battlefield.

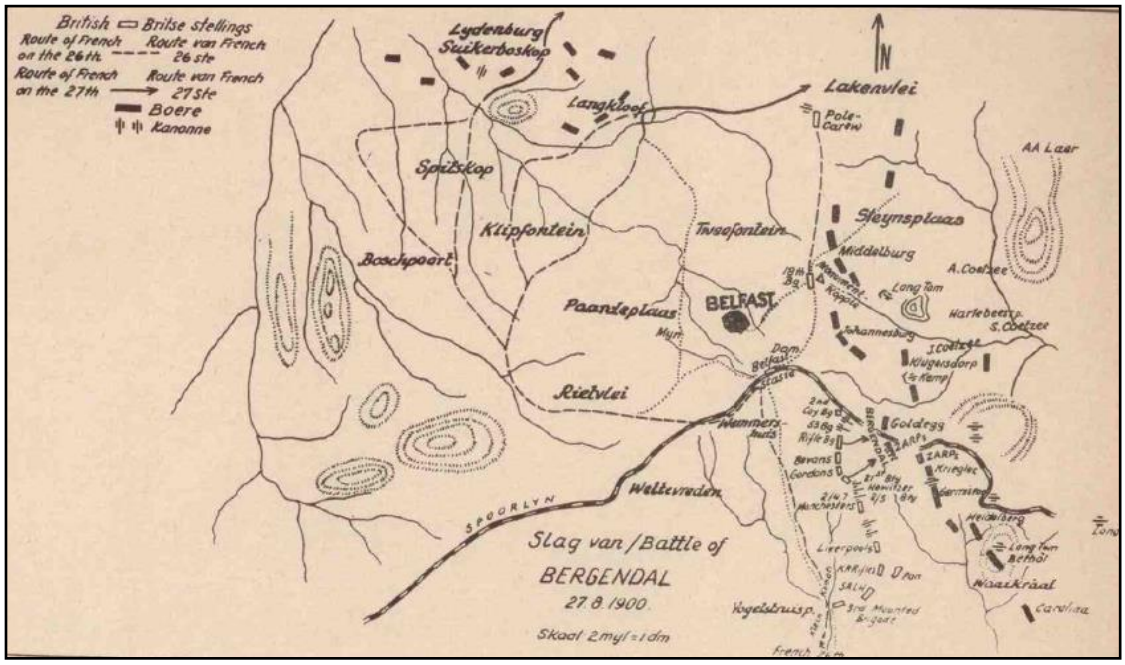

Figure 7 - Map: Battle of Bergendal (VD Merwe, 1952)

4.8 Belfast Concentration Camp Graves and British Military Graves

During the Second South African (Anglo-Boer) War, the British established a concentration camp in and around Belfast. The cemetery containing the graves of Boer/Afrikaans civilians who died in the camp is located on the outskirts of the south-western edge of the town. The cemetery also contains British and Commonwealth military graves from the Second South African War. (UCT database of British Concentration Camps of the South African War 1900-1902; http://www2.lib.uct.ac.za/mss/bccd/)

4.9 Palaeontological Background

4.9.1 Geological background

The proposed consolidation footprint of the Ilima Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits as topsoil (**Figure 8**).

The Permo-Carboniferous Dwyka Group forms the lowermost and oldest deposit in the Karoo Supergroup. These deposits were deposited in a cold, glacially-dominated environment which occurred when South Africa lay beneath a massive ice sheet. Track ways, coprolites (fossilized faeces), body fossils of marine fish, gastropods and invertebrates have been recovered as well as fossil plants including fossilized leaves, wood, spores and pollens. The rocks of the Dwyka are of low palaeontological sensitivity as fossil assemblages is uncommon. The Vryheid Formation is well-known for its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, palaeoniscoid fish, small crustaceans, insects, trace fossils track ways, organic-walled spores and pollens as well as petrified wood. The mesosaurid reptile, *Mesosaurus* may also be present in the development site. The sedimentary rocks of the Vryheid Formation have a very high fossiliferous potential and thus a very high palaeontological sensitivity. The Dolerite of the Jurassic has a very low Palaeontological Sensitivity as these rocks are unfossiliferous. The fossil assemblages of the Quaternary deposits (low palaeontological sensitivity) are usually rare, low in diversity, and occur over a wide geographic area. The fossil heritage of Quaternary deposits have been neglected in the past, although they sometimes contain important fossil biotas.

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. Regardless of the sparse and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific importance as many fossil taxa are known from a single fossil.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

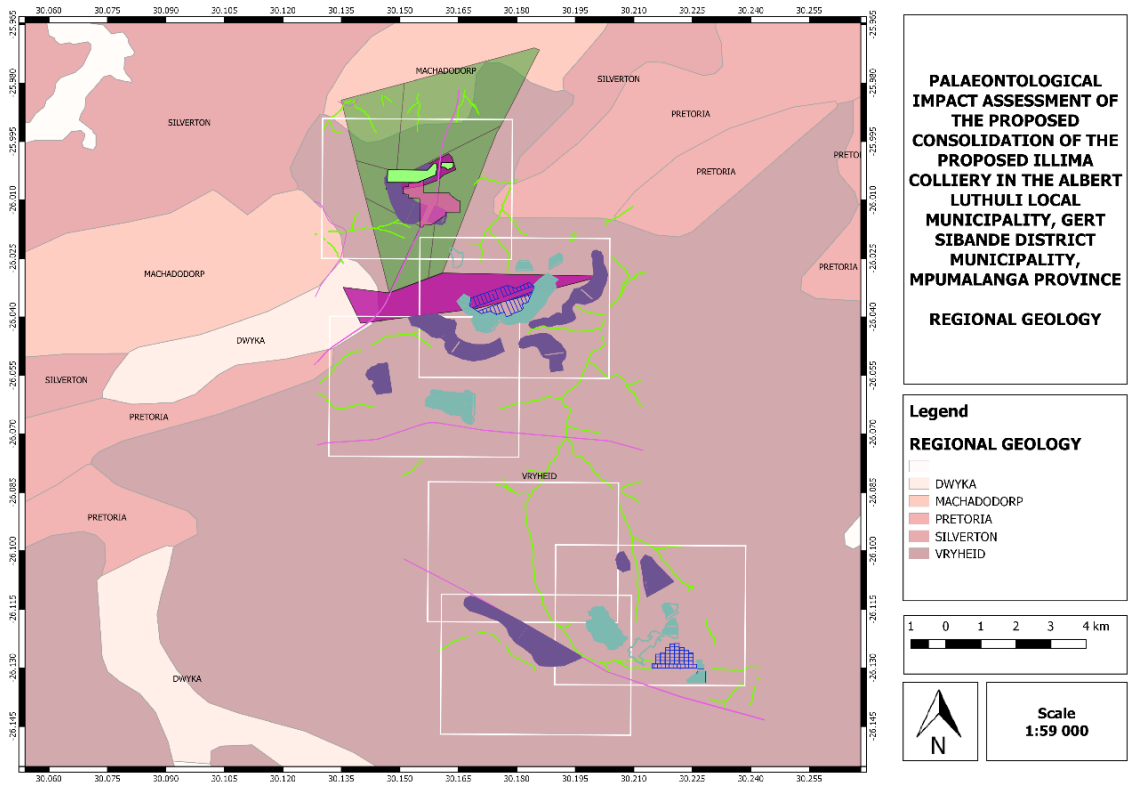

Figure 8 - The surface geology of proposed consolidation of the proposed Illima Colliery in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. The development site is completely underlain by by sedimentary rocks of the Permo-Carboniferous Dwyka Group); Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits as topsoil.

4.10 Findings of the Heritage background study

The archival research and topographic maps suggest that during the field assessment we can expect to locate historic structures and possible Iron Ages features as well as formal and informal cemeteries.

5 FIELD WORK FINDINGS

Due to the nature of cultural remains, with the majority of artefacts occurring below the surface, a controlled-exclusive surface survey was conducted over a period of 4 days by vehicle and on foot by two archaeologists from PGS. The fieldwork was conducted from the 4th – 7th September 2017. The fieldwork was logged with GPS receiver and all finds marked (**Figure 9** and **Figure 10**).

During the field assessment, a total of 23 heritage sites were located. These include 5 cemeteries (**ILM001**, **ILM002**, **ILM008**, **ILM010**, and which have fencing or berms enclosing them, 3 historic grave sites (**ZV02, ILM006** and **ILM011** unprotected), 4 informal cemeteries (**ILM 012**, **ILM013**, **ILM017** and **ILM018** unprotected), 2 possible graves (**ILM009** and **ILM016**), 9 structures **ILM003**, **ILM004**, **ILM007**, **ILM014**, **ILM015, ZV04-07** and one possible site of mining infrastructure **ILM005**. Refer to **Figure 12** and **Figure 13** for the locality of the identified heritage resources in relation to the mining areas.

Figure 14 and **Figure 15** indicates the correlation between field finds and the First Edition topographical maps that shows relative ages of some of the structures.

Many of the sites have already been exposed and opencast mining is currently in process. Therefore, assessment of those sites for heritage remains was not possible. Satellite imagery which was observed before the site visit suggests that there were no significant buildings or stone-walls present in these areas.

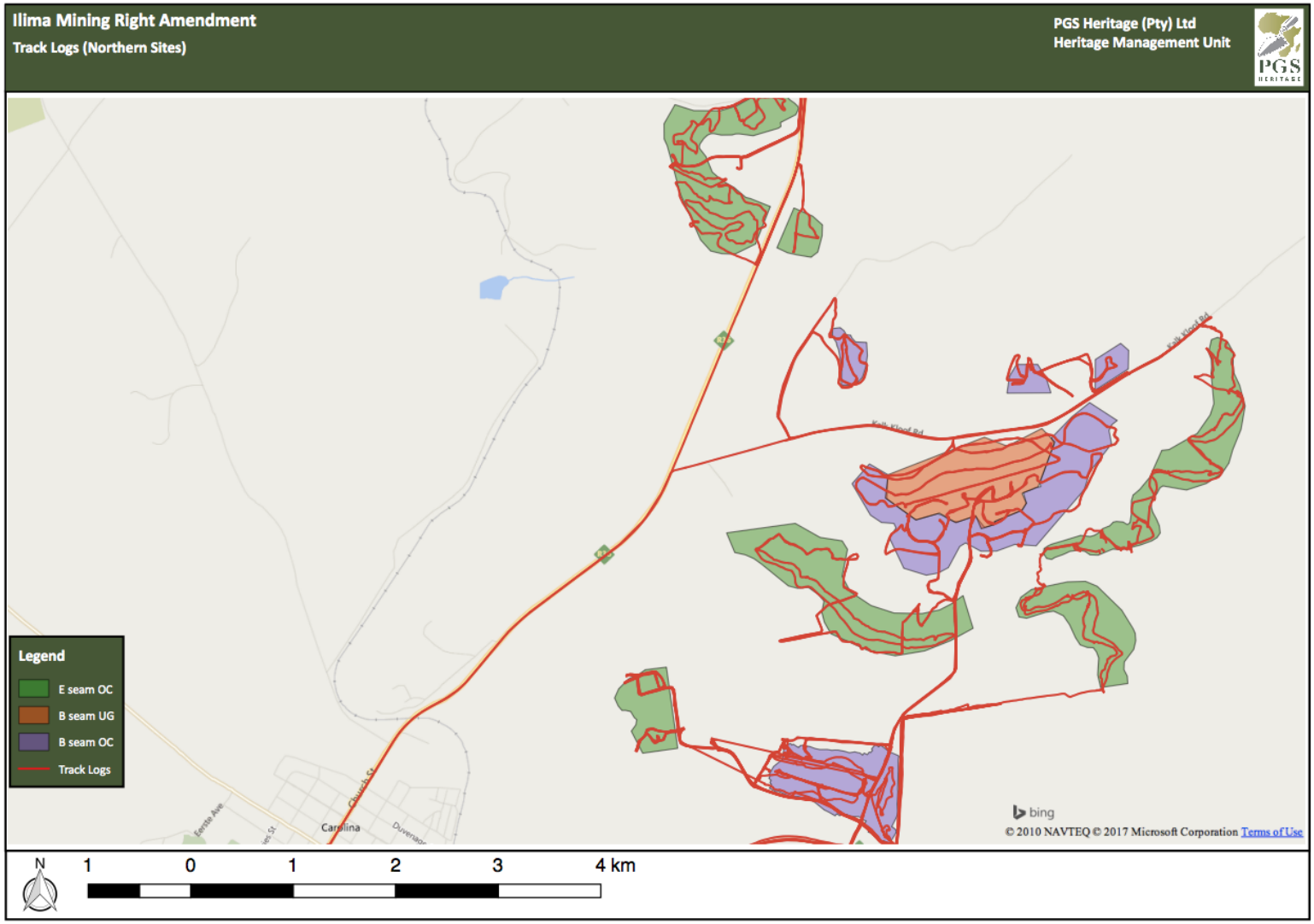

Figure 9 – Track log of field assessment of the northern sites.

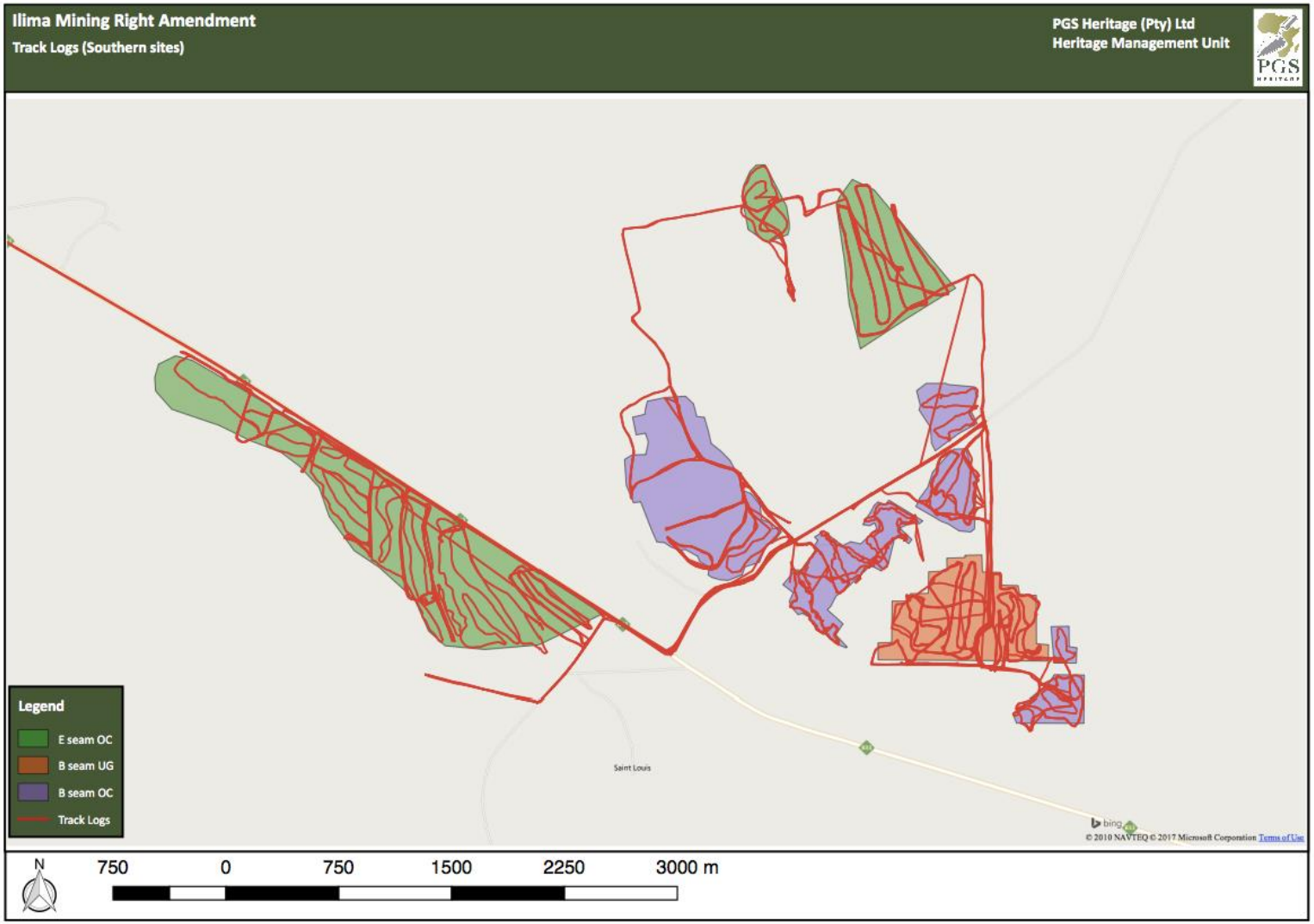

Figure 10 - Track log of field assessment of the southern sites

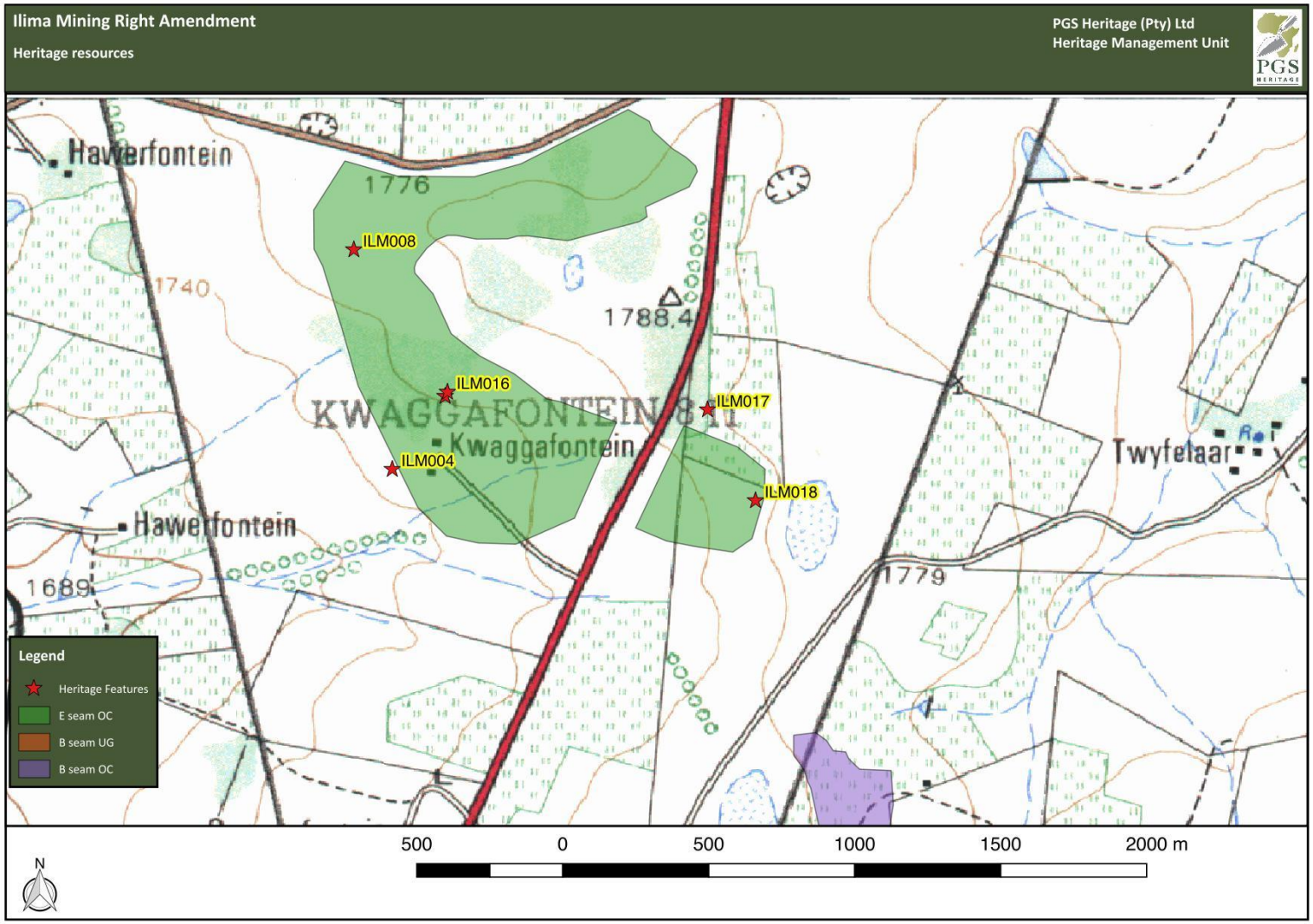

Figure 11- Located heritage features (northern section)

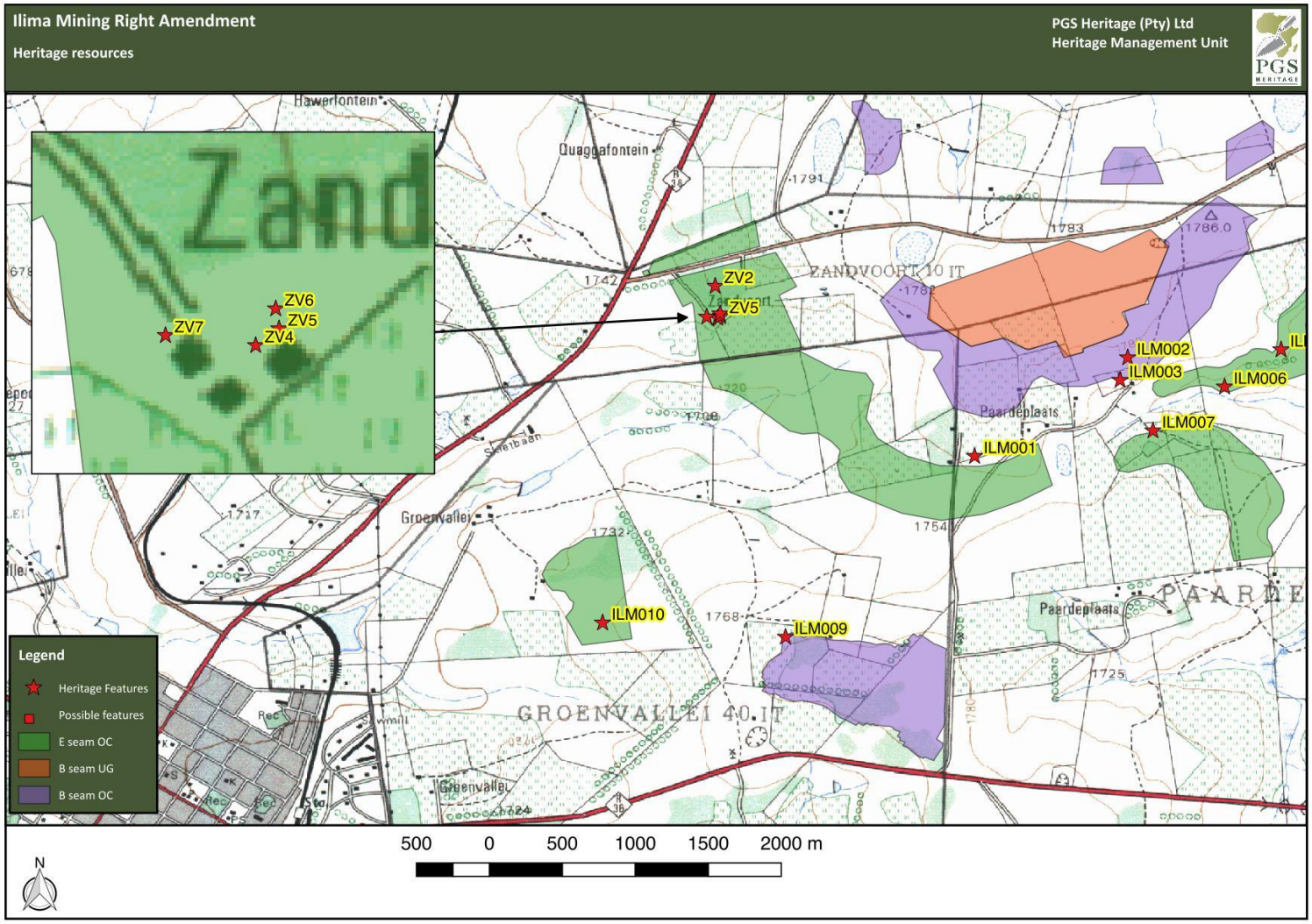

Figure 12- Located heritage features (central section)

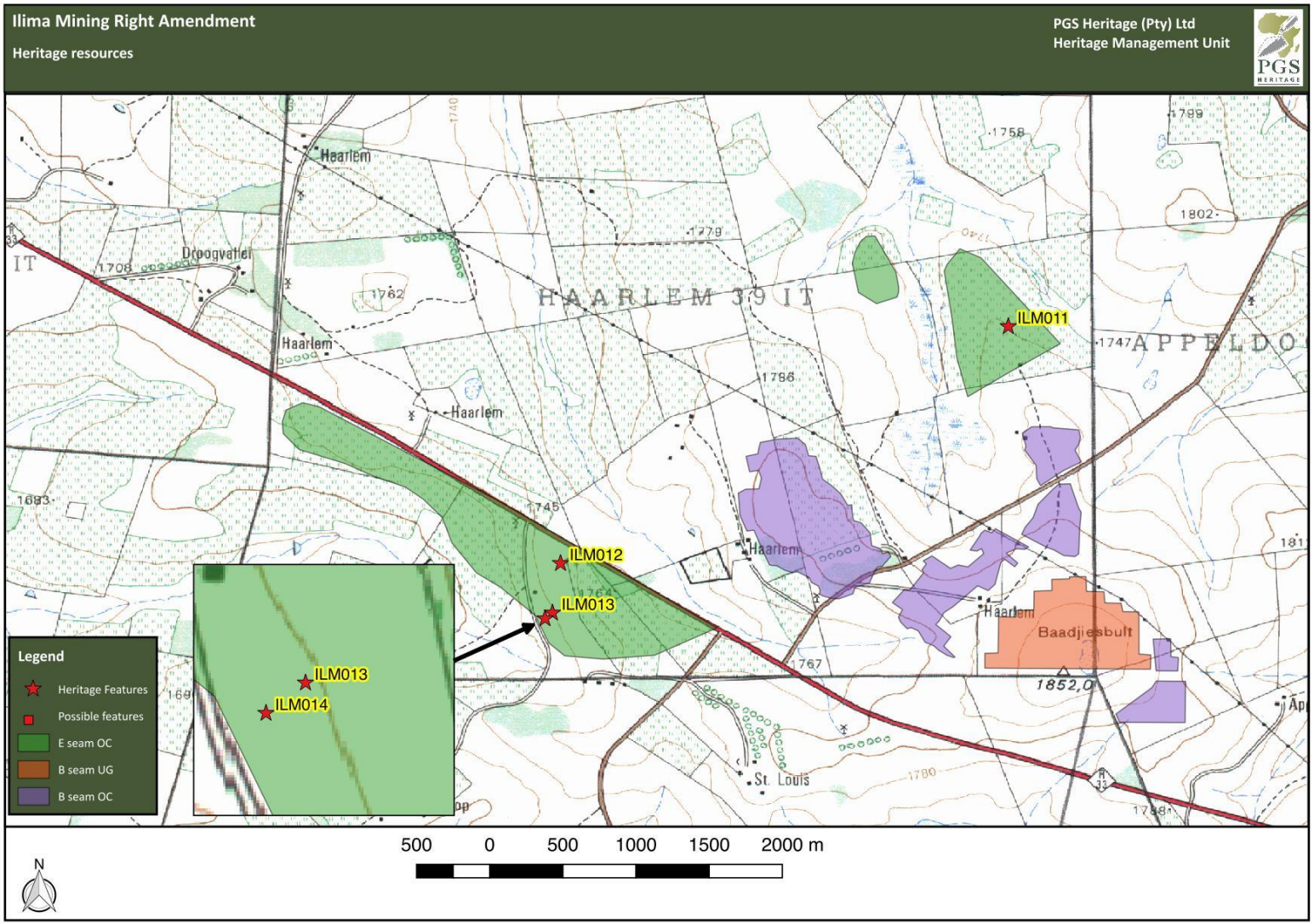

Figure 13 – Located heritage features (southern sites)

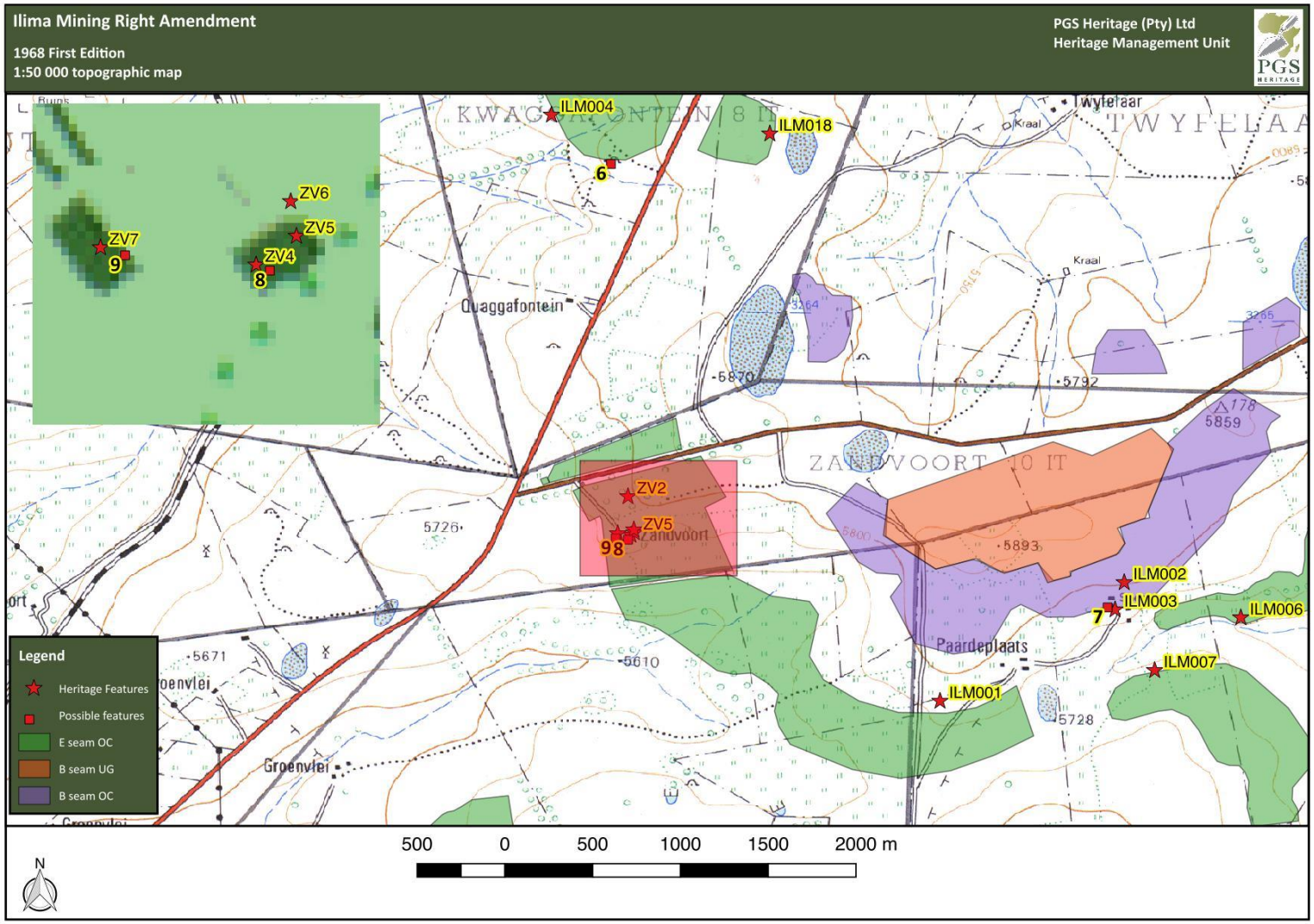

Figure 14 – Located heritage finds which occur on the topographic sheet. ILM003 is represented by depicted site No7 (shed). ZV5-7 represented by points 8 and 9.

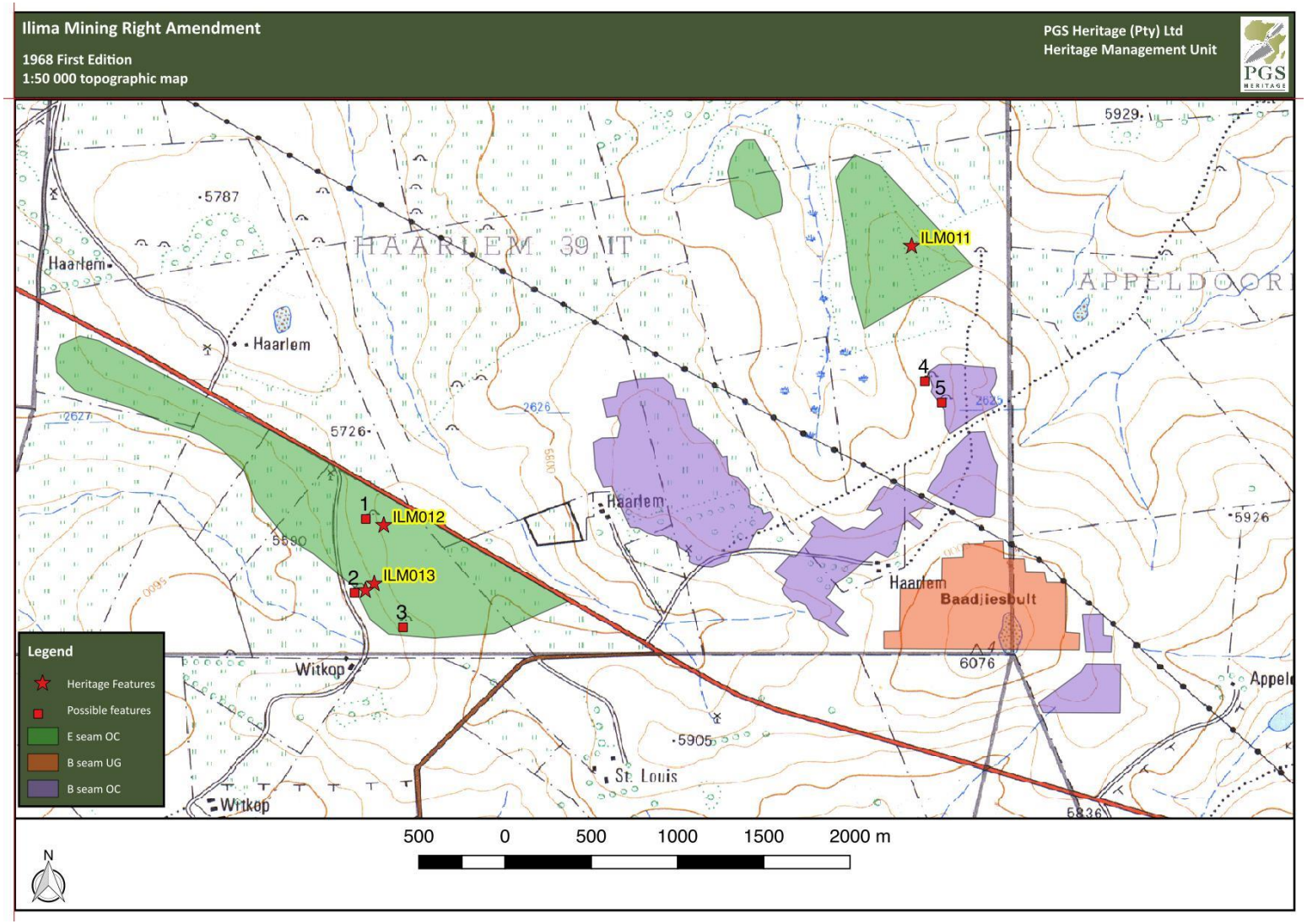

Figure 15 - Located heritage finds which occur on the topographic sheet. ILM012 and 013 are represented by depicted site No1 and 2

5.1 Site descriptions.

5.2 Site ILM001:

GPS: -26.046644° 30.171157°

Description: A fenced off burial ground was identified at this location.

Some of the graves have formal granite dressings with an inscribed granite headstone, others are unmarked or stone packed. There are approximately 28 graves that are orientated in an east to west direction that occur within this Burial ground.

Mining area: This site occurs just outside the study area but should be noted and avoided. Outside for field E -OC

Site size: 25m x 25m.

Site significance: GP.A

Figure 16 – Burial ground at ILM001

Figure 17 – Stone packed graves at ILM001

5.3 Site ILM002

GPS: -26.039894° 30.181645°

Description: A formally fenced off Burial ground was identified at this location.

Most of the graves have formal granite dressings with an inscribed granite headstone, with only a few being unmarked or stone packed. There are approximately27 graves that are orientated in an east to west direction that occur within this burial ground. This burial ground is well maintained and most likely still visited.

Mining area: For field B - OC

Site size: 25m x 20m.

Site significance: GP.A

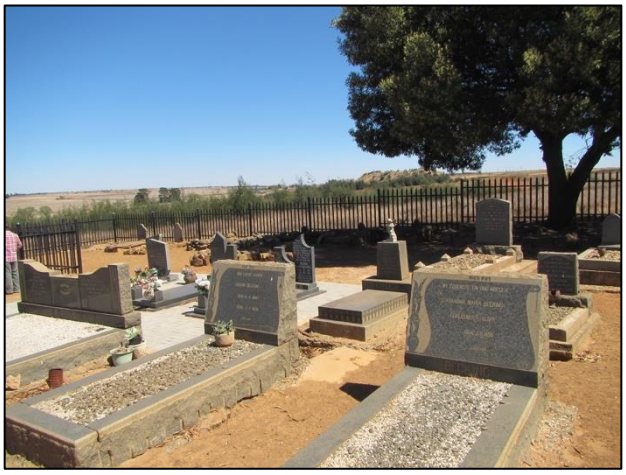

Figure 18 – Burial ground at ILM002

Figure 19 – Formal fence at ILM002

5.4 Site ILM003

GPS: -26.041441° 30.181122°

Description: Two small sandstone brick structures were identified at this location. It is evident that the buildings have been altered at some stage with red brick and cement. The site is also identified on the topographic maps as sheds and more than likely older than 60 years.

Mining area: On the boarder for field B - OC

Site size: 15m x 10m. and 4 x 5m

Site significance: Provisional Grading GP.B

Figure 20 – Historic structure at ILM003

Figure 21 – Building style and alterations at ILM003

5.5 Site ILM004:

GPS: -26.013275° 30.149032°

Description: A neatly backed stone walled kraal occurs at this location. There are features identified on the topographic maps that may suggest this is older than 60 years. However, it does not occur in the study area and of little significance

Mining area: Outside of the area for field E - OC

Site size: 25m x 25m.

Site significance: GP.B

Figure 22 – Kraal at ILM004

Figure 23 – Full view of Kraal at ILM004

5.6 Site ILM005:

GPS: -26.039351° 30.192150°

Description: Closed up borehole pipe was identified at this location.

Mining area: For field E - OC

Site size: 1 x 1m.

Site significance: None

Figure 24 – Pipe extending from the ground at ILM005

Figure 25 – Pipe has been sealed off

5.7 Site ILM006:

GPS: -26.041895° 30.188282°

Description: Stone walled structures were located here. There are 3 structures with outer walls consisting old large rocks and a pile of smaller packed stone in the centre. This is more than likely historical graves, but could also be that of Iron Age remains. Due to the thick vegetation it was difficult to visually access the site.

Mining area: For field E – OC

Site size: 10m x 10m.

Site significance: GP.A

Figure 26 – Stone walled feature at ILM006

Figure 27 – Clear view of outer wall enclosing an inner pile of smaller packed stone.

5.8 Site ILM007:

GPS: -26.044899° 30.183378°

Description: A historic sand stone structure occurs at this location. There is no record of the site on the topographic maps, however due to the nature of the design it can be assumed to be older than 60 years. There are two structures, the first is multi roomed the second a small shed. Both structures have wooden lintels in place as well as exceptionally thick iron bars on the windows. The purpose of this structure is uncertain.

Mining area: Just outside of the area for field E - OC

Site size: 12 x 12m and 3 x 4m.

Site significance: Provisionally graded GP.B

Figure 28 – General view of the main structure from behind.

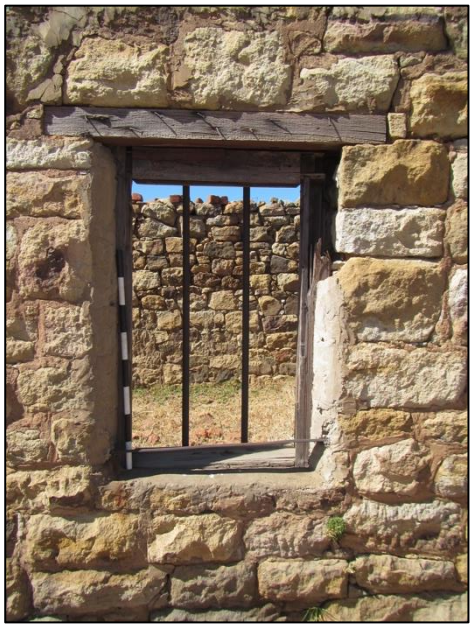

Figure 29 – View of barred windows at ILM007

Figure 30 – Front of ILM007 showing collapsed pillars

Figure 31 – Smaller shed behind the main structure (windows also barred)

5.9 Site ILM008:

GPS: -26.005767° 30.147716°

Description: A burial ground is located here. There are approximately 14 graves in an east to west orientation. Some graves have more formal cement dressings while others are stonepacked. The burial ground is fenced off, but the fence is in a poor state

Mining area: For field E - OC

Site size: 15m x 15m.

Site significance: GP.A

Figure 32 – general view of graves at ILM008

Figure 33 – Burial ground at ILM008

5.10 Site ILM009:

GPS: -26.059017° 30.158205°

Description: A possible grave occurs at this location. This is a stone packed pile resembling a grave with an east to west orientation. This site will need to be accessed further to determine whether or not it is a grave through test excavations.

Mining area: For field B - OC

Site size: 2m x 1m.

Site significance: GP.A

Figure 34 – Possible grave

5.11 Site ILM010:

GPS: -26.058045° 30.145673°

Description: An informal burial ground occurs here in an active mining area. The burial ground consists of approximately 6-10 stone packed graves in a poor state of preservation. Due to the nature of the site and the established trees within the graves, it can be assumed the burial ground is historic, however it does not feature on the topographic maps. The burial ground has been cornered off already by means of a two foot high berm.

Mining area: For field E - OC

Site size: 30m x 30m.

Site significance: GP.A

Figure 35 – Berm around the burial ground at ILM010

Figure 36 – Poorly preserved grave dressings at ILM010

5.12 Site ILM011:

GPS: -26.106662° 30.216321°

Description: Historic graves occur at this location. Two square stone enclosures containing two to three graves at an east to west orientation.

Mining area: For field E - OC

Site size: 4m x 8m.

Site significance: GP.A

Figure 37 – Stone enclosure with historic graves at ILM011

Figure 38 – General view of ILM011

5.13 Site ILM012:

GPS: -26.122848° 30.185706°

Description: An informal burial ground occurs at this location. There are approximately 18 graves at an east to west orientation. Most the graves are stone packed and well maintained there are also two brick covered graves one cement and granite dressed grave. The family that resides in close proximity claims most the graves, however, there are several that do not belong to the family and are unkept.

Mining area: For field E - OC

Site size: 20m x 15m.

Site significance: GP.A

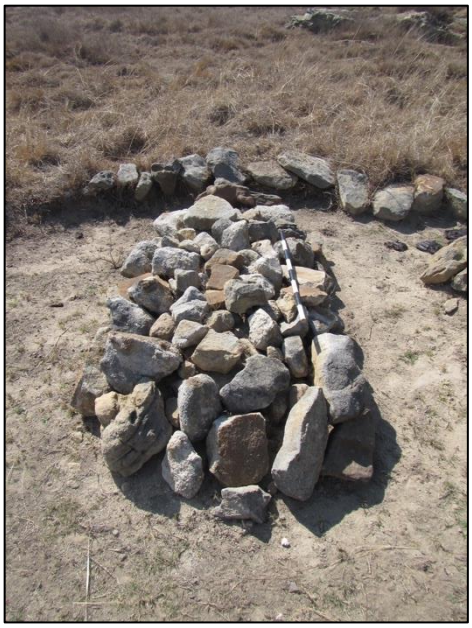

Figure 39 – well maintained grave at ILM012

Figure 40 – General view at ILM012

5.14 Site ILM013:

GPS: -26.126240° 30.185154°

Description: An informal burial ground occurs at this location. Approximately 9 graves occur here at different orientations. Two graves appear to be facing a north to south direction. There is also a small kraal which occurs about 10 m away from the burial ground.

Mining area: For field E - OC

Site size: 10m x 10m.

Site significance: GP.A

Figure 41 – Graves at ILM013

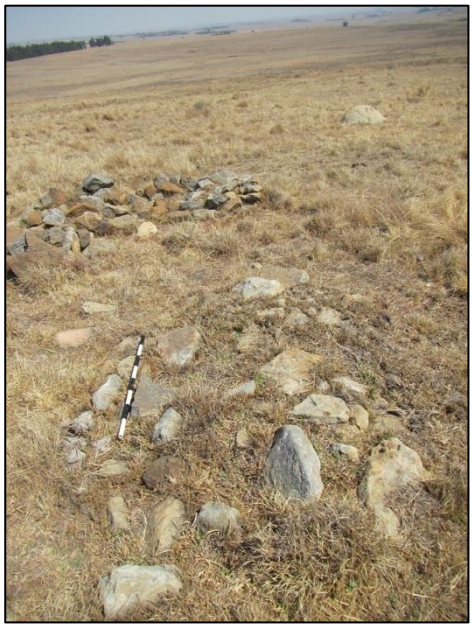

Figure 42 – Differing orientations of graves at ILM013.

5.15 Site ILM014:

GPS: -26.126631° 30.184645°

Description: Remains of 13-14 historical mud wall structures occur at this location. These features are present on the topographical maps and the burial ground at ILM013 is possibly related to this small homestead. The remaining walls are about half a meter in height but the shape of the structures is clear.

The possibility of stillborn graves associated with these structures as per African cultural believes must be considered. Refer to the management recommendations in Section 7 of this report.

Mining area: For field E - OC

Site size: 40m x 35m.

Site significance: GP.A

Figure 43 – Outlines of mud-walled structures at ILM014

Figure 44 – General view of structures at ILM104

5.16 Site ILM015:

GPS: -26.010779° 30.150839°

Description: The remains of a single mud-walled structure occurs at this location. Only the foundations remain. No evidence of this structure occurs on the topographic maps. The possibility of stillborn graves associated with these structures as per African cultural believes must be considered. Refer to the management recommendations in Section 7 of this report.

Mining area: For field E - OC

Site size: 5m x 5m.

Site significance: GP.B

Figure 45 – Remains of mud-walled structure at ILM015

Figure 46 – General view of ILM015

5.17 Site ILM016:

GPS: -26.010633° 30.150921°

Description: A single possible grave occurs at this location. This is a stone packed pile resembling a grave with an east to west orientation. This site will need to be accessed further to determine whether or not it is a grave through test excavations.

Mining area: For field E - OC

Site size: 1m x 2m.

Site significance: GP.A

Figure 47 – Possible grave at ILM016

5.18 Site ILM017:

GPS: -26.011239° 30.159822°

Description: Two stone packed graves occur at this location. The graves are east to west and in a poor state of preservation

Mining area: Just outside of area for field E - OC

Site size: 3m x 3m.

Site significance: GP.A

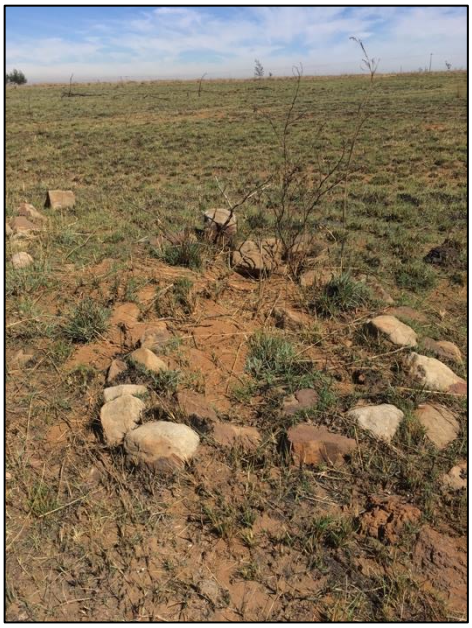

Figure 48 – View of a grave at ILM017

Figure 49 – Two graves at ILM017

5.19 Site ILM018:

GPS: -26.014348° 30.161465°

Description: three stone packed graves with a stone outer wall occur at this location

Mining area: For field E - OC

Site size: 5m x 5m.

Site significance: GP.A

Figure 50 – View of graves at ILM018

Figure 51 – View of graves at ILM018

5.20 ZV 2:

Site Coordinates: *S26.03500° E30.15339°*

Description:

This site consists of a formal white cemetery of the Davel family and is located roughly 240 m north of the farm dwelling at **ZV4**. Three marked graves were identified in a single row with a possible fourth grave indicated by a low soil heap. The cemetery is enclosed by a rectangular stone wall which has an access gate on its southern end. The cemetery does not appear to have been visited recently as it is not well maintained.

All the graves are orientated along the east-west axis and the three marked ones have granite headstones on their western ends with rectangular granite lined dressings. The details depicted on these inscribed headstones are provided below.

TER GEDAGTENIS AAN ONS GELIEFDE SEUN EN BROER WYNAND J. DAVEL GEB: 27 APR. 1916 OORL: 25 FEB. 1941 PS: 34 - 2	TER NAGEDAGTENIS AAN ONS GELIEFDE EGGENOOT EN VADER J.G.A. DAVEL GEB. 16 AUG. 1865 OVERLEDEN 1 FEB. 1923 PS. 23. DE HEER IS MYN HERDER.	IN LIEFDEVOLLE HERINNERING AAN ONS DIERBARE MOEDER HESTER MARIA GEB. (VAN NIEKERK) 8-11-1870. OORL. 28-8-1945. KOM NA MY ALMAL EK SAL JULLE RUS GEE DAVEL

It is evident from the names appearing on these three marked graves that they belonged to the Davel family. During the archival research undertaken for the present study it was found that a Johannes Gerhardus Albertus Davel (16 August 1865 – 1 February 1923) acquired the farm Zandvoort on 6 March 1911. It is evident that the J.G.A. Davel on the headstone of the oldest grave from this cemetery is one and the same as Johannes Gerhardus Albertus Davel. He owned the farm until his death on 1 February 1923. In terms of his estate the farm was subdivided between two of his sons namely Tobias Davel (who acquired the eastern portion) and Wynand J. Davel (who acquired the western portion). Wynand J. Davel, who is the second person buried at this cemetery, passed away at the young age of 24. His western portion of the farm was subsequently subdivided and transferred to his mother Hester Maria Davel (born Van Niekerk) and three other siblings. Ms. Davel remained on this portion of the farm until her death on 28 August 1945. She was buried in the same cemetery with her husband and son.

Site size: 15 m x 5 m

Mining area: Just outside of area for field E - OC

Site Significance:

Graves and burial grounds have high levels of emotional, religious and historical significance. As a result the site has a **GP. A**

Figure 20–The grave of Johannes Gerhardus Albertus Davel.

Figure 21–The grave of Hester Maria Davel (born Van Niekerk).

Figure 22–The grave of Wynand Jacobus Davel

5.21 ZV 4:

Site Coordinates: *S26.03719° E30.15356°*

Description:

A historic farm dwelling is located here. It was erected on a solid sandstone foundation that was built in such a way that a terraced appearance against the slight slope of the site was created. As a result the foundation on the lower end of the slope (the building's southern facade) is roughly 0.5 m high whereas the sandstone foundation on the higher side of the building (the northern facade) is nearly invisible. While sections of the walls were certainly built of brick, other presently plastered and painted sections may have been of sandstone as well. This is however not certain.

The dwelling has a ventilated hipped roof of corrugated iron which allowed for the placement of two triangular wooden ventilator louvers directly under the roof's ridge on both the eastern end western ends of the building. These louvers provided ventilation through the roof and possible attic space and allowed for a better ventilated building (Mauritz Naudé, pers. comm.).

The front and back facades of the dwelling are characterised by the presence of a verandas on those ends. According to architectural historian Mauritz Naudé this is a characteristic of "...*most farm houses...*" in South Africa (Naudé, 2010:26). In the case of the dwelling under discussion, its

northern veranda is still relatively intact whereas the northern facade has been changed to such an extent that just the veranda pillars can still be seen.

The eastern end of the dwelling is characterised by a rectangular pitched roof section which flanks the entire width of the building including the two verandas. While it is possible that this building represents the result of connecting two stoepkamers with one another, it may also be possible that it represents an original component to the house. The northern and southern gabled sections would have had a fireplace as is indicated by the presence of a chimney on each end. Furthermore, the front (northern) gable section contains the remains of a wooden gable decoration as well as a circular attic ventilator.

It is evident that the dwelling was significantly altered over the years. These alterations are especially evident on the northern, eastern and western facades of the building. As indicated before, the veranda on the northern facade (including its roof section) was removed whereas modifications were made to the eastern and western ends.

In establishing the age of a historic building various sources of information can be used successfully, including the dating of a building based on its architectural styles and architectural detailing used as well as an assessment of historical and archival maps and references.

In terms of architectural style and detailing, for example, the wooden gable decoration still evident on the dwelling was very popular during the South African War (1899 – 1902) when the British Army shipped large numbers of corrugated iron cantonments in crates from England for easy erection across Southern Africa. Such gable decoration may as a result have been acquired from a disused British cantonment in the Carolina District and placed on the building. It is also important to note that the wooden gable decoration was popular during the Edwardian Period (1900 – 1915) when the metal decoration of the Victorian Period was increasingly replaced with wooden features. This means that the wooden decoration on this building may date to the period between roughly 1900 and 1910 (Mauritz Naudé, pers. comm.).

The design of the two chimneys was popular during the period from 1880 to 1902, but in some cases can be found in the period after the war as well ((Mauritz Naudé, pers. comm.).

From the above-mentioned architectural information it is clear that the building can most likely be dated to the Edwardian Period between 1900 and c. 1910. The archival and historical maps

and diagrams assessed as part of this study have shown that the farm dwelling is not depicted on a survey diagram that was compiled in 1896 and seemingly also not on a map from c. 1913. However, it is worth noting that it is not exactly certain when this latter map was surveyed in the field. While the map was likely printed in 1913, the surveys may very well have been undertaken a few years prior. From this information it would appear that the dates suggested by the architectural style and details may hold true.

With this as background, one can identify the person responsible for the construction of the building from the farm ownership history obtained during the archival research. As indicated elsewhere, the portion of the farm where this dwelling is located would over the years have been owned by a number of different individuals and companies. This ownership history commenced with Gerhardus Theodorus Becking (3 August 1869), James Martin Williams (10 January 1876), Frans Coenraad Dekker (7 February 1876), the Cape Commercial Bank (4 August 1879), Hermann Ludwig Eckstein (7 December 1880), the Transvaal Consolidated Land & Exploration Company Limited (11 June 1892) and Johannes Gerhardus Albertus Davel (6 March 1911). The latter person owned the farm until his death in 1926.

A number of these previous owners can immediately be excluded from the list of possible builders of the farm dwelling. These include James Martin Williams who owned the farm for less than a month, companies such as the Cape Commercial Bank and the Transvaal Consolidated Land & Exploration Company Limited as well as the businessmen Hermann Ludwig Eckstein. The only remaining potential builders of the house would be Gerhardus Theodorus Becking, Frans Coenraad Dekker and Johannes Gerhardus Albertus Davel. Becking and Dekker can also be excluded from the list as any building erected by them would have appeared on the 1896 diagram and would not have been built in an Edwardian style which is dated from 1900 to 1915. From this it seems highly likely for the building to have been erected by Johannes Gerdhardus Albertus Davel shortly after his acquisition of the farm on 6 March 1911.

It is evident that the building is older than 100 years and can be classified as an archaeological site.

Mining area: Just outside of area for field E - OC

Site size: 30 m x 20 m.

Site Significance: The site possesses high levels of historic, architectural and emotional significance. The building has however been significantly altered and modified over time. As a result the site has a **GP. B – Medium Significance**.

Figure 25 – Various views of the farm dwelling at ZV4. The top image depicts the northern facade with the middle image the southern facade. The two images at the bottom depict the eastern facade and a gabled wing.

5.22 ZV 5:

Site Coordinates: *S26.03706° E30.15375°*

Description:

A rondavel is located a short distance to the east of the farm dwelling. Its walls are of dressed sandstone and the building has a wooden door facing the dwelling. The only other openings in the structure are two small rectangular windows. The doorframe, window frames and lintels above the openings are all of wood. The building would originally have had a thatched roof, but is presently covered by corrugated iron sheets.

The building is a typical outbuilding and would in all likelihood have been used either as a milk room or meat room. Its position so close to the dwelling would have facilitated such an extension to the food preparation activities of the farmstead.

It can be expected that the rondavel was built at roughly the same time as the farm dwelling.

Mining area: Just outside of area for field E - OC

Site size: Approximately 4m in diameter.

Site Significance: The site possesses high levels of historic and architectural significance and represents a reasonably common feature of the vernacular Highveld farms architecture. The site has a **GP. B – Medium Significance**.

Figure 26 – General view of the rondavel structure. Note the lintel, door and doorframe all manufactured of wood.

Figure 27 – Another view of the rondavel structure. Note the small rectangular window with wooden frame and lintel.

5.23 ZV 6:

Site Coordinates: *S26.03689° E30.15372°*

Description:

A double garage is located here which is partially built of dressed sandstone and partially of bricks. It would appear that the dressed sandstone components of this structure would have been directly associated with the original farmstead and is quite likely as old as the farm dwelling. At the time the structure may have been used as a wagon shed or possibly as a general purpose farm shed. In later years the building would have been re-purposed as a double garage and workshop.

Mining area: Just outside of area for field E - OC

Site size: Approximately 15 m x 10 m.

Site Significance: The site possesses high levels of historic and significance. The site has a **GP. B – Medium Significance**

Figure 28 – General view of the structure.

5.24 ZV 7:

Site Coordinates: *S26.03711° E30.15281°*

Site Description:

An "L" shaped shed is located roughly 60 m from the farm dwelling. Significant sections of the shed contain dressed sandstone walls with smaller components built of brick. The south-eastern corner of the building appears to have been its original core and has well-built dressed sandstone

walls with sandstone lintels above the window and door openings. Other sections of the overall building also have sandstone walls, but these appear more rudimentary and would in all likelihood have been erected at the same time that the brick sections were built.

The original core would have been used as a milking shed, and this function appears to have been carried through into later years.

This original milking shed would have been built at the same time as the farm dwelling.

Mining area: Just outside of area for field E - OC

Site size: Approximately 34 m x 34 m x 10 m

Site Significance:

The site possesses high levels of historic and architectural significance and has a **GP. B – Medium Significance**

Figure 29 – The south-eastern corner of the building representing what appears to be the oldest component of the site. Sandstone lintels above the window and door openings can be seen on the right.

Figure 30 – Different phases in the construction and use of the building can be seen from this image. The brick sections on the left would have represented a second or potentially third building phase with the sandstone component on the right potentially younger than the sandstone section on the south-eastern end of the site.

6 IMPACT ASSESSMENT

The aim of the impact evaluation is to determine the extent of the impact of the proposed project on the identified heritage resources and predict possible impacts on unidentified heritage resources.

During the field work a total of eighteen heritage related sites were identified. These can be subdivided into burial grounds, and recent historic structures. It must be considered that the heritage significance of the identified site plays a role in the evaluation of the impact and must influence the magnitude rating of the impact tables. Thus a heritage resource with a high heritage significance rating will have a higher impact magnitude rating as a resources with a low or no heritage significance rating. Consequently, mitigation measures will be more extensive for a heritage resource with a high heritage significance than those with a low heritage significance.

All the impacts are envisaged to happened during construction activities. Where there is an impact during Operations/Mining this is mentioned pertinently in the following section.

6.1 Status Quo and "No Go" option

6.2 Status Quo

No fatal flaws were identified from a cultural, historical, archaeological and paleontological perspective

6.3 "No go" Option

No such option is contemplated.

6.4 Project Impact

6.5 Heritage resources and sensitivity

Table 11 indicates the locality of each identified heritage resource in relation to the proposed mining areas.

Table 11: Heritage resources in relation to development areas

Resource Number	Type	Heritage Grading	Impact Zone
ILM01	Burial ground	GP.A	Just outside E Seam OC
ILM02	Burial ground	GP.A	B Seam OC
ILM03	Structure	Provisionally GP.B	B Seam OC
ILM04	Structure	GP.B	E Seam OC
ILM05	Borehole pipe	None	E Seam OC
ILM06	Structure	GP.A	E Seam OC
ILM07	Structure	Provisionally GP.B	E Seam OC
ILM08	Burial ground	GP.A	E Seam OC
ILM09	Burial ground	GP.A	B Seam OC
ILM010	Burial ground	GP.A	E Seam OC
ILM011	Burial ground	GP.A	E Seam OC
ILM012	Burial ground	GP.A	E Seam OC
ILM013	Burial ground	GP.A	E Seam OC
ILM014	Structure	GP.A	E Seam OC
ILM015	Structure	GP.B	E Seam OC
ILM016	Burial ground	GP.A	E Seam OC
ILM017	Burial Ground	GP.A	Outside E Seam OC
ILM018	Burial Ground	GP.A	E Seam OC

Resource Number	Type	Heritage Grading	Impact Zone
ZV2	Burial Ground	GP.A	E Seam OC
ZV4	Burial Ground	GP.A	E Seam OC
ZV5	Burial Ground	GP.A	E Seam OC
ZV6	Burial Ground	GP.A	E Seam OC
ZV7	Burial Ground	GP.A	E Seam OC

The identified heritage resources are allocated a sensitivity buffer based on the general accepted management buffers accepted by SAHRA in the past few years. No regulations in the NHRA provides guidelines on buffer zones. In the case of heritage sensitivity, a buffer of 20 – 50 meters is proposed based on the type of heritage resource. In the case of BGG a buffer of 50 meters is generally proposed and 20 meters for a heritage structure such as ruins and other built structure (**Figure 52** - **Figure 54**).

The Mine Health and Safety Act No. 29 of 1996, Regulation 17(7), however further determines that no mining can take place closer than 100 meters from man-made structures such as cemeteries. **Figure 52** - **Figure 54** provides an indication of the 100 meter buffers required around BGG sin the event that the BGG is not relocated.

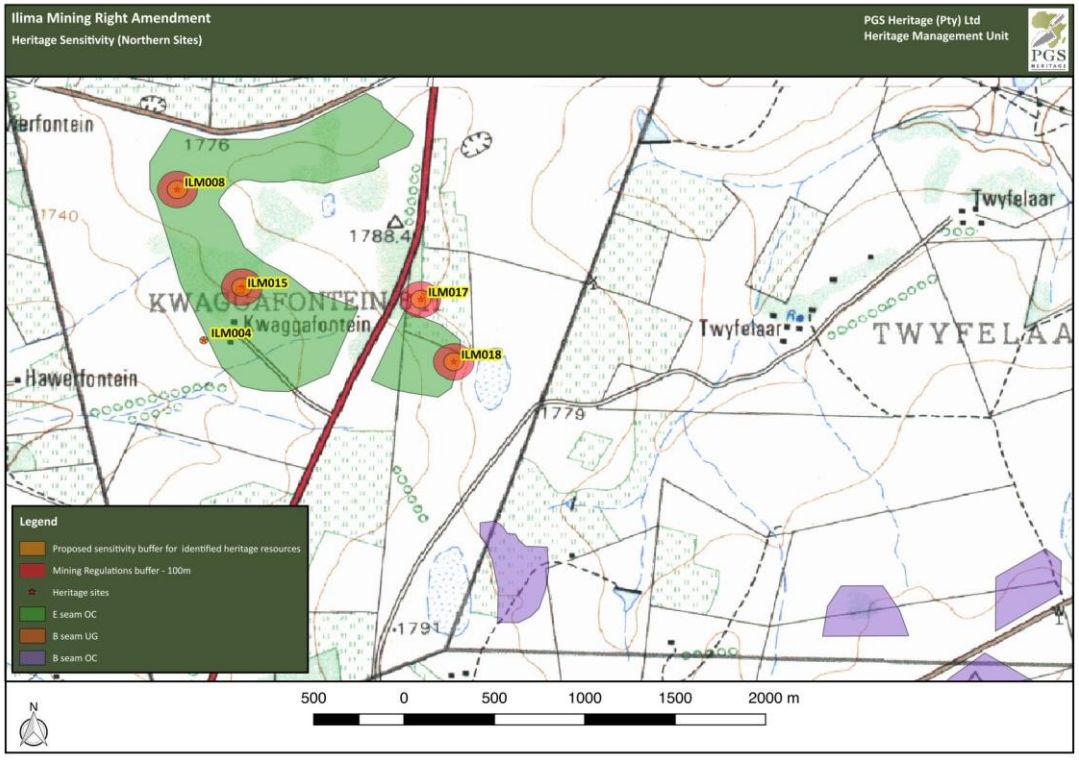

Figure 52 - Proposed management buffers based on heritage sensitivities of the resources identified – northern section

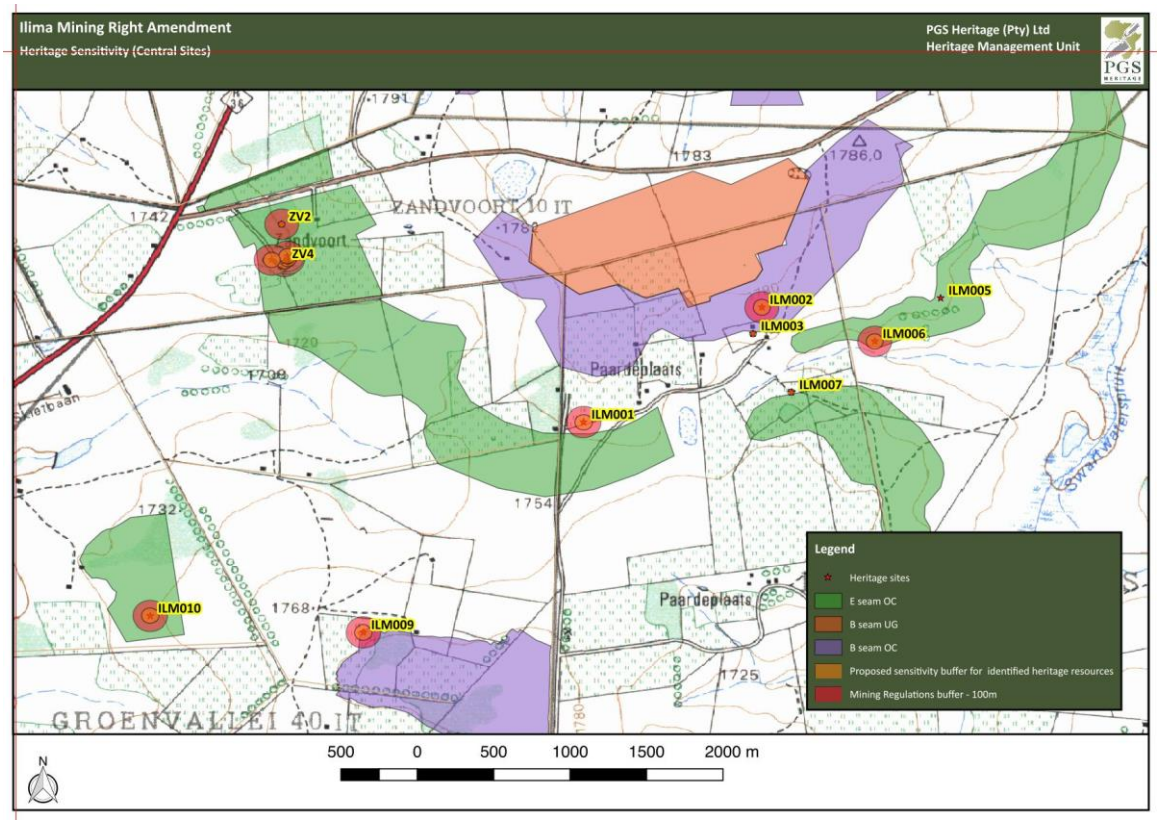

Figure 53 - Proposed management buffers based on heritage sensitivities of the resources identified – central section

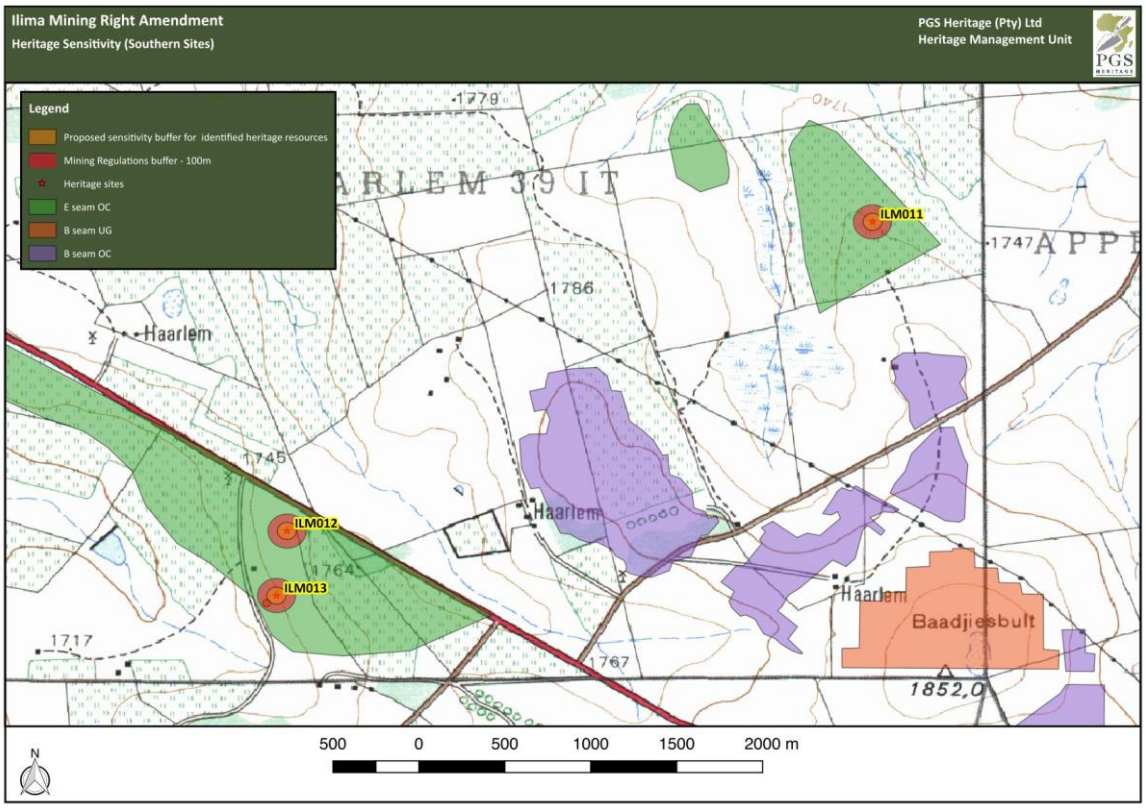

Figure 54 - Proposed management buffers based on heritage sensitivities of the resources identified – southern section

6.6 Impact on recent historic structures

A total of eleven recent historic structures were identified of which one (**ILM05**) have no heritage significance. The remaining ten historic heritage resources (**ZV04-07**, **ILM003**, **ILM004**, **ILM006**, **ILM007**, **ILM014**, and **ILM015**) are all rated as having a medium to high heritage significance. This is based on the probability of infant or stil born burials occurring around the structures (**ILM014 and 015**). Such burials are a part of African customs (and must be considered during vegetation and soil clearing around these sites).

All the historic structures (**ZV04-07**, **ILM003**, **ILM004**, **ILM007**, **ILM014**, and **ILM015**) will be directly impacted by mining. The impact significance rated as MEDIUM negative before mitigation and with the implementation of the mitigation measures the impact significance is reduced too LOW negative.

Table 12 – Impact assessment table - Destruction of heritage structures

Impact Name	**Destruction of heritage structures**				
Alternative	**none**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	1	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	5	2
Environmental Risk (Pre-mitigation)					-18.75
Mitigation Measures					
In the case of ZV04-07, ILM003, ILM004 and ILM007 the sites will need to documented before a destruction permit can be applied for at the provincial heritage authority (Mpumalanga). ILM014 will need to be fully mitigated with excavations and documentation of the site. No mitigation is required for ILM015. In the event of any other heritage resources are uncovered SAHRA should be contacted and a qualified archaeologist appointed to evaluate the finds and make appropriate recommendation on mitigation					
Environmental Risk (Post-mitigation)					-6.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.67
Final Significance					-10.00

6.7 Impact on burial grounds

Twelve (12) burial ground in total have been identified during the field work. Due to the social and cultural significance of burial grounds and graves a high heritage significance is given to these sites. The twelve cemeteries can be divided in to four (4) cemeteries (**ILM001**, **ILM002**, **ILM008** and **ILM010** have fencing or berms enclosing them, 3 historic grave sites (**ZV02**, **ILM006** and **ILM011** unprotected), 4 informal cemeteries (**ILM 012**, **ILM013**, **ILM017** and **ILM018** unprotected), and 2 possible graves (**ILM009** and **ILM016**).

The impact of the proposed project on the burial grounds (excluding **ILM01** and **ILM017** that will not be directly impacted by mining activities) is rated as having a HIGH negative significance before mitigation and with the implementation of mitigation measures as having a LOW negative significance.

Table 13 - Assessment of impact of mining on burial grounds

Impact Name	**Destruction of burial grounds**				
Alternative	**none**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	2
Extent of Impact	2	1	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	5	2
Environmental Risk (Pre-mitigation)					-20.00
Mitigation Measures					
Demarcate sites with a 50-meter buffer and avoid them. If the sites cannot be avoided a grave relocation process will need to take place. Stakeholder engagement will need to be implemented to determine the possibility of infant burials at ILM014 and 015.					
Environmental Risk (Post-mitigation)					-6.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.50
Final Significance					-9.00

In the event of any heritage resources being uncovered SAHRA should be contacted and a qualified archaeologist appointed to evaluate the finds and make appropriate recommendation on mitigation

The combined weighted project impact to the heritage resources (prior to mitigation) is medium. After mitigation the impacts will be low to medium.

7.3 Impact on Paleontological Resources

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. Regardless of the sparse and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific importance as many fossil taxa are known from a single fossil.

The impact of the proposed project on the palaeontology is rated as having a LOW negative significance before mitigation and with the implementation of mitigation measures as having a LOW negative significance.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

Table 14 - Assessment of impact of mining on palaeontological resources

Impact Name	**Destruction of palaeontology**				
Alternative	**none**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	1
Duration of Impact	5	5	Probability	3	1
Environmental Risk (Pre-mitigation)					-9.75
Mitigation Measures					
• *The EAP and ECO for the Ilima Colliery ought to be informed that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains, although they are mostly trace fossil and plant fossil assemblages.*					

• *In areas that are allocated a Very High and High Palaeontological sensitivity and specifically where deep excavation into bedrock is expected, a qualified palaeontologist must be employed to evaluate and record fossils at the development footprint. The fossils may be placed on a stock pile where a professional palaeontologist may inspect them at regular intervals (determined by the mine and palaeontologist).* • *These recommendations must form part of the EMP of the Ilima Colliery mining project.*	
Environmental Risk (Post-mitigation)	-2.50
Degree of confidence in impact prediction:	High
Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1.50
Final Significance	-3.75

7 MANAGEMENT RECOMMENDATIONS AND GUIDELINES

7.1 Construction phase

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area and small-scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however foundation holes do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure, such as construction camps and laydown areas, is often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure is implemented.

7.2 Chance find procedure

- A heritage practitioner should be appointed to develop a heritage induction program and conduct training for the ECO as well as team leaders in the identification of heritage resources and artefacts.
- An appropriately qualified archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated and construction activities halted.
- The qualified archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the archaeologist.

7.3 Possible finds during construction

The study area contains numerous old homesteads as identified during the fieldwork. Excavations of foundations and soil clearance can uncover the following:

- Stone foundations;
- Ash middens associated with the farmsteads and homesteads that can contain bone, glass and clay ceramics, ash, metal objects such as spoons, knives, and knives.
- Possible infant burials;

7.4 Timeframes

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for collection or excavation of heritage resources and lead times must be worked into the construction time frames. **Table 15** gives guidelines for lead times on permitting.

Table 15: Lead times for permitting and mobilisation

ACTION	RESPONSIBILITY	TIMEFRAME
Preparation for field monitoring and finalisation of contracts	The contractor and service provide	1 months
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	1 month
Documentation, excavation and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – Graves/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of cemetery or graves in the way of construction	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

7.5 Heritage Management Plan for EMP implementation

NO.	MITIGATION MEASURES	PHASE	TIMEFRAME	RESPONSIBLE PARTY FOR IMPLEMENTATION	MONITORING PARTY (FREQUENCY)	TARGET	PERFORMANCE INDICATORS (MONITORING TOOL)	COST
Possible finds								
A	Implement chance find procedures in case where possible heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	**Possibly R50 000**
Known sites								
Structures	• In the case of **ZV04-07**, **ILM003**, **ILM004** and **ILM007** the sites will need to documented before a destruction permit can be applied for at the provincial heritage authority (Mpumalanga). • **ILM014** will need to be fully mitigated with excavations and documentation of the site. • No mitigation is required for **ILM015**. • In the event of any other heritage resources are uncovered SAHRA should be contacted and a qualified archaeologist appointed to evaluate the finds	Construction	During construction	Applicant ECO	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	**Between R100-200 000**

NO.	MITIGATION MEASURES	PHASE	TIMEFRAME	RESPONSIBLE PARTY FOR IMPLEMENTATION	MONITORING PARTY (FREQUENCY)	TARGET	PERFORMANCE INDICATORS (MONITORING TOOL)	COST
	and make appropriate recommendation on mitigation.							
Burial Grounds	• Demarcate sites with a 50-meter buffer and avoid them. • Stakeholder engagement will need to be implemented to determine the possibility of infant burials at **ILM014** and **015**. • If this is not possible a detailed grave relocation process must be implemented as required under the NHRA and National Health Act regulations.	Construction	During construction	Applicant ECO	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	**Approximately R3-4 mil**
Palaeontology	• The EAP and ECO for the Ilima Colliery ought to be informed that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains, although they are mostly trace fossil and plant fossil assemblages. • In areas that are allocated a Very High and High Palaeontological sensitivity and specifically where deep excavation into bedrock is expected, a qualified palaeontologist must be employed to evaluate and record fossils at the development footprint. The fossils may be placed on a stock pile where a professional palaeontologist may inspect them at regular intervals	Construction through to Operational	Construction Operational	Applicant ECO Palaeontologist	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	**Less than R100 000**

NO.	MITIGATION MEASURES	PHASE	TIMEFRAME	RESPONSIBLE PARTY FOR IMPLEMENTATIO N	MONITORING PARTY (FREQUENCY)	TARGET	PERFORMANCE INDICATORS (MONITORING TOOL)	COST
	(determined by the mine and palaeontologist). • These recommendations must form part of the EMP of the Ilima Colliery mining project.							

8 CONCLUSION

PGS was appointed by ESS to undertake an HIA that forms part of the Environmental Impact Assessment (EIA) as part of the proposed extension of the mining operations at the existing Ilima colliery (old Pembani colliery), near Carolina, Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

The HSR completed as part of the HIA process has shown that the proposed LCPP may have heritage resources present in the study area. This has been confirmed through archival research and evaluation of aerial photography and topographical maps of the sites.

Evaluation of aerial photography has indicated the following area that may be sensitive from a heritage perspective.

These findings provided the basis for the recommendation of further field truthing through a heritage field study and palaeontological desktop study covering the site.

During the field assessment, a total of 23 heritage sites were located. These include 5 cemeteries (**ILM001**, **ILM002**, **ILM008**, **ILM010**, and which have fencing or berms enclosing them, 3 historic grave sites (**ZV02, ILM006** and **ILM011** unprotected), 4 informal cemeteries (**ILM 012**, **ILM013**, **ILM017** and **ILM018** unprotected), 2 possible graves (**ILM009** and **ILM016**), 9 structures **ILM003**, **ILM004**, **ILM007**, **ILM014**, **ILM015, ZV04-07** and one possible site of mining infrastructure **ILM005**.

The management and mitigation measures as described in Section 7 of this report have been developed to minimise the project impact on heritage resources.

It is my considered opinion that overall impact on heritage resources after the implementation of the recommended mitigation measures is acceptably low and that the project can be approved from a heritage perspective.

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ANNEXURE A – PALAEONTOLOGICAL IMPACT ASSESSMENT

PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED CONSOLIDATION OF THE PROPOSED ILIMA COLLIERY IN THE ALBERT LUTHULI LOCAL MUNICIPALITY, GERT SIBANDE DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

Prepared for:

PGS Heritage (Pty) Ltd

DATE: 18 September 2017

Prepared by

BANZAI ENVIRONMENTAL (PTY) LTD

EXECUTIVE SUMMARY

Ilima Coal Company (Pty) Ltd (previously known as Pembani Coal Company), and from now on referred to as Ilima, proposes the expansion of their current approved mining operations on their Ilima Colliery (previously known as Pembani Colliery). Ilima Coal Company (Pty) Ltd. has an approved Mining Right (MP 30/5/1/2/2/112 MR) and EMPR in terms of the MPRDA for the mining of coal at Ilima Coal. The planned new mining development falls within the list of properties approved under the NEMA (Ref #: (EA) 17/2/3/GS-44) for a range of listed activities. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is essential to detect the presence of fossil material within the proposed development footprint and to evaluate the impact of the construction and operation of the proposed development on the palaeontological resources.

The proposed consolidation footprint of the Ilima Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits.

The Permo-Carboniferous Dwyka Group forms the lowermost and oldest deposit in the Karoo Supergroup. This Group is characterized by the presence of trace fossils (track ways, coprolites), body fossils of marine fish, gastropods and invertebrates as well as fossil plants. The rocks of the Dwyka are of low palaeontological sensitivity. The Vryheid Formation of the Ecca Group is world renowned for the presences of coal beds which has been formed due to the accumulation of plant material over long periods of time. Trace fossils, fish, small crustaceans, insects, as well as petrified wood, spores and pollens are common in this Formation. The sedimentary rocks of the Vryheid Formation have a very high palaeontological sensitivity. The Dolerite of the Jurassic has a very low palaeontological sensitivity as these rocks are unfossiliferous. The fossil assemblages of the Quaternary deposits (low palaeontological sensitivity) are usually rare, low in diversity, and occur over a wide geographic area.

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. Regardless of the rare and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific significance as many fossil taxa are known from a single fossil.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations, the ECO in charge for these developments ought to be informed immediately. Such discoveries must be protected (preferably *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to ensure that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

The specialist would need a collection permit from SAHRA. Fossil material ought to be curated in an approved collection (*e.g.* museum or university) and all fieldwork and reports ought to meet the minimum standards for palaeontological impact studies developed by SAHRA.

Recommendations:

1. The EAP and ECO for the Ilima Colliery ought to be informed that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains. The fossils are mostly trace fossil and plant fossil assemblages.
2. A qualified palaeontologist must be employed to evaluate and record fossils at the development footprint. The fossils may be placed on a stockpile where a professional palaeontologist may inspect them at regular intervals (determined by the mine and palaeontologist).
3. These recommendations ought to form part of the EMP of the Ilima Colliery mining project.

CONTENTS

1 INTRODUCTION

Ilima Coal Company (Pty) Ltd proposes the expansion of their current approved mining operations on their Ilima Colliery (**Fig. 1-3**). Ilima Coal Company (Pty) Ltd. has an approved Mining Right (MP 30/5/1/2/2/112 MR) and EMPR in terms of the MPRDA for the mining of coal at Ilima Coal. The planned new mining development falls within the list of properties approved under the NEMA (Ref #: (EA) 17/2/3/GS-44).

The proposed mine infrastructure will include:

- Opencast pits or underground mining;
- Haul roads;
- Storm water management infrastructure;
- Contractors camp including workshop, diesel storage, offices and ablution facilities;
- Raw water dams and PCD's;
- Water pipelines and associated water management infrastructure;
- Administrative offices;
- Security and fencing;
- Product stockpiles;
- Discard and overburden stockpiles;
- Topsoil stockpiles;
- Monitoring boreholes;
- Highwall entrance to underground;
- Underground mining sections;
- Opencast mining sections;
- Conveyors (underground conveyors transporting coal to surface); and
- Site camp associated with underground mine entrance.

It is the objective of this Environmental Impact Assessment Report amendment to provide information on the proposed changes with regards to the amendment to include extra underground and opencast mining of coal resources at Ilima Colliery. The proposed future mining areas (within the existing mining right) include:

- New underground mining operations:
    - Portions of the farm Haarlem 39 IT; and
    - Portion RE/9 of the farm Appeldoorn 38 IT.

- New opencast mining operations:
    - Portions RE and 1 of the farm Zandvoort 10 IT;
    - Portion 6 of the farm Kwaggafontein 8 IT;
    - Portions RE and 2 of the farm Haarlem 10 IT;
    - Portions 2, 8 and 16 of the farm Groenvallei 40 IT;
    - Portion 2 and 12 of the farm Paardeplaats 12 IT;
    - Portion 9 of the farm Appeldoorn 38 IT; and
    - Portion RE of the farm Leeupoort 13 IT.

The Ilima Colliery has been in operation since 2008. Most of the construction of the mine infrastructure has been completed, including mine offices, a wash plant, workshop facilities, dirty water containment facilities, etc. Extensive opencast mining has taken place, but the mine has only recently started with underground mining. The mining activities (opencast and underground) have and will be approached as a phased development over the LoM (30 years).

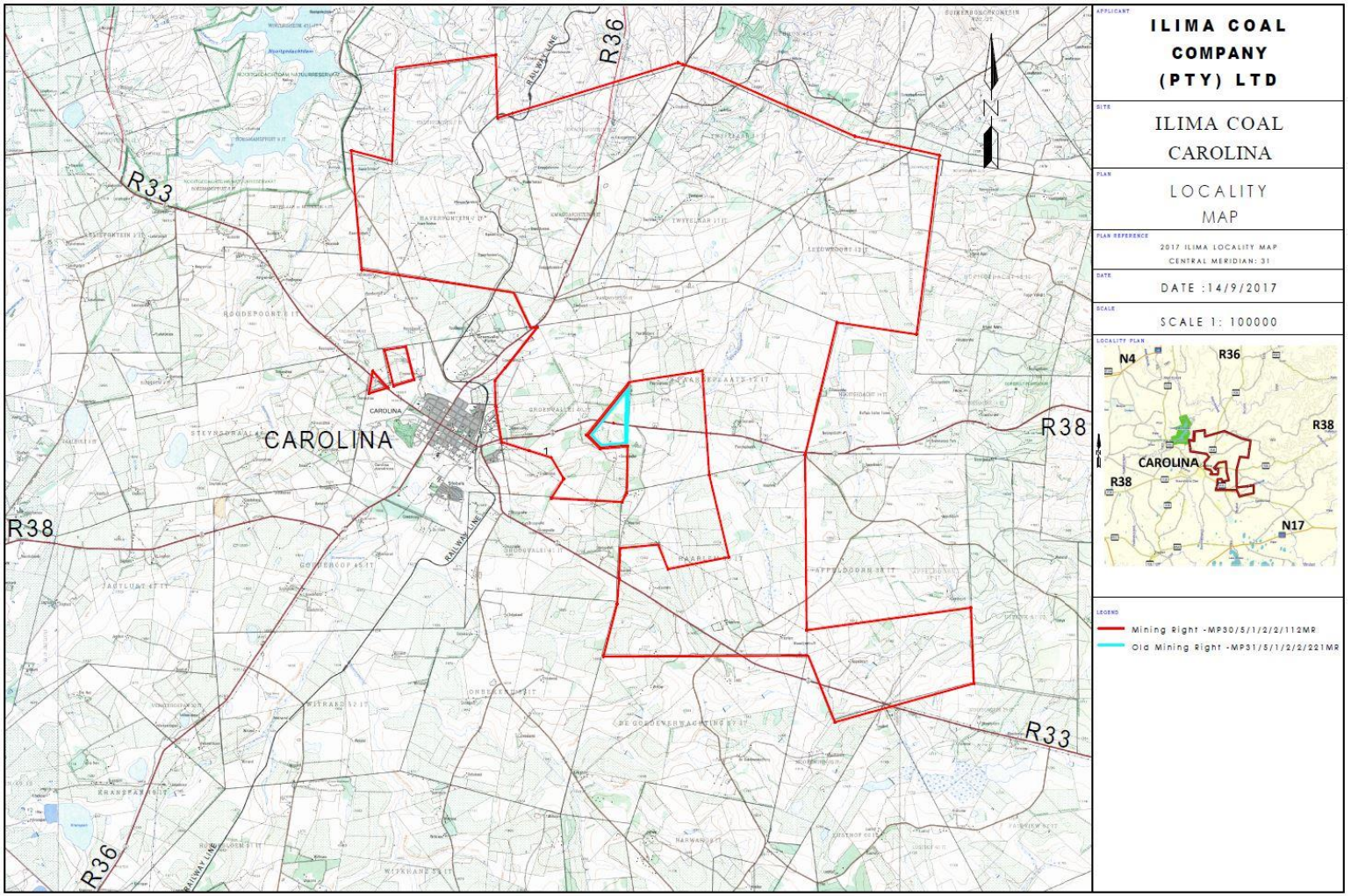

Figure 1: Locality map of the Ilima Colliery. (Map povided by GeoSoil and Water).

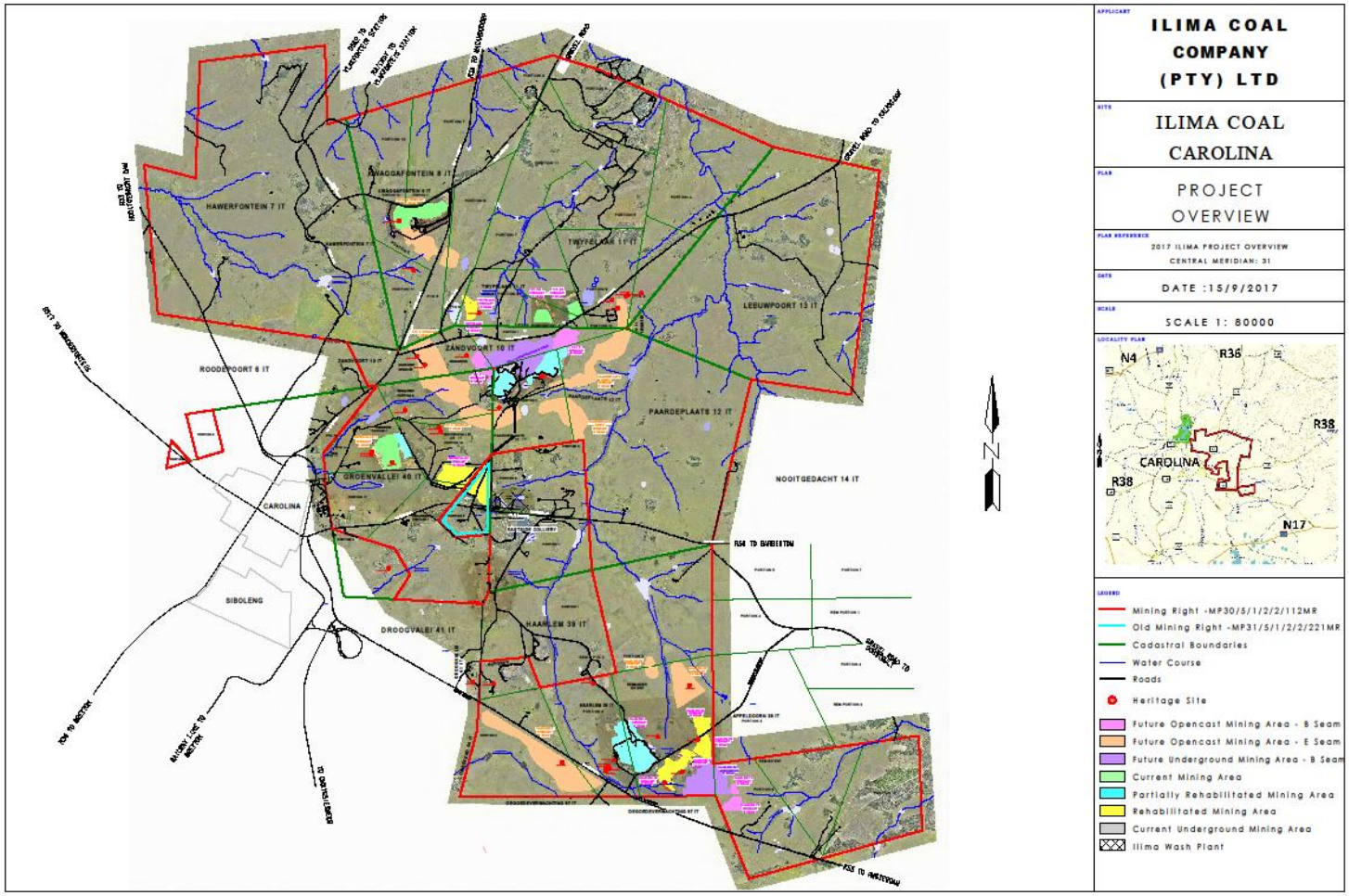

Figure 2: Ilima project overview. (Map provided by GeoSoil and Water).

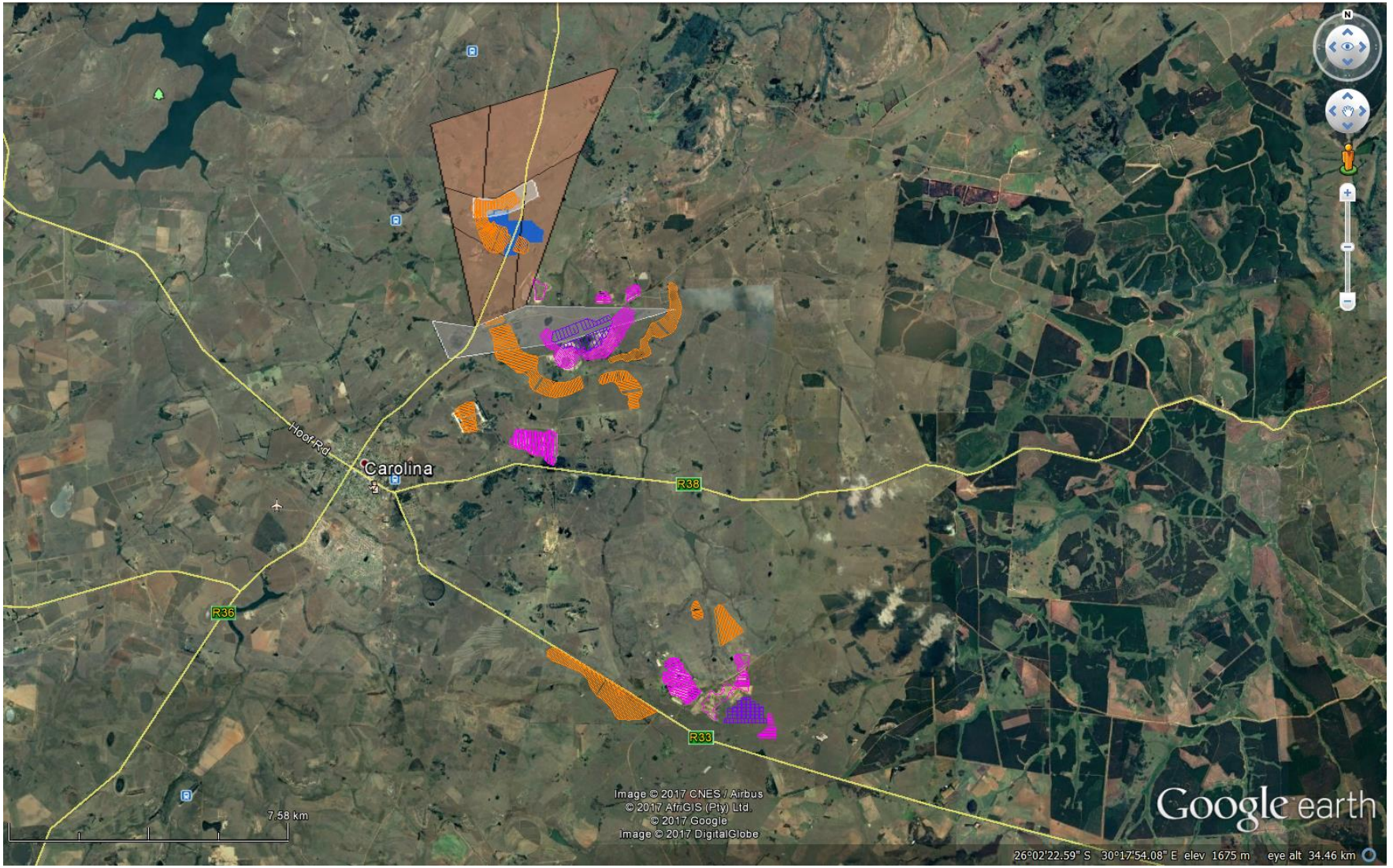

Figure 3: Google Earth Image of the proposed mining activities. Orange indicates the Opencast E Seam-planned and Current mining, pink indicates opencast B Seam-proposed mining; purple indicates the planned underground B Seam mining and yellow indicates the rehabilitated mining area.

2 LEGISLATION

Cultural Heritage in South Africa is overseen by the National Heritage Resources Act (Act 25 of 1999) (NHRA). This Palaeontological Impact Assessment (PIA) forms part of the Heritage Impact Assessment (HIA) and abide by the requirements of the above mentioned Act. In accordance with Section 38, an HIA is required to evaluate any potential impacts to palaeontological heritage within the site.

2.1 Section 35 of the National Heritage Resources Act 25 of 1999

In Section 3 of the NHRA, several categories of heritage resources are recognized as part of the National Estate. This comprise among others:

- geological sites of scientific or cultural importance
- palaeontological sites
- palaeontological objects and material, meteorites and rare geological specimens

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- All archaeological objects, palaeontological material and meteorites are the property of the State.
- Any person who unearths 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.
- No person may, without a permit issued by the responsible heritage resources authority—
    - Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
    - Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological 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 palaeontological material or object, or any meteorite; or
    - Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted

and no heritage resources management procedure in terms of section 38 has been followed, it may—

- Serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order; and/or
- Carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary.

3 SCOPE

According to the South African Heritage Resources Agency's (SAHRA) Archaeology, Palaeontology and Meteorites (APM) Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports, the aims of the palaeontological impact assessment are:

- To identify exposed and subsurface rock formations that are considered to be palaeontologically important;
- To evaluate the level of palaeontological importance of the formations;
- To comment on the impact of the development on the uncovered and/or potential fossil resources; and
- To recommend how the developer ought to conserve or mitigate damage to these resources.

The objective is thus to conduct a PIA, which forms of part of the HIA and the Environmental Impact Assessment (EIA) Report, to determine the impact of the development on potential palaeontological material at the site.

When a palaeontological desktop/scoping study is prepared, the potentially fossiliferous rocks (i.e. groups, formations, etc.) presented within the study area are established from geological maps. The known fossil resources within each rock unit is obtained from published scientific literature; the fossil sensitivity maps (SAHRIS); discussions with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions. This data is used to calculate the palaeontological importance/sensitivity of each rock unit of the development area on a desktop level. The probable impact of the proposed development footprint on local fossil heritage is thus established on the basis of

- the palaeontological sensitivity of the rocks and
- the nature and scale of the development footprint and extent of new bedrock excavated.

If rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is necessary. Damaging impacts on palaeontological heritage generally only occur during the construction phase. The excavations will modify the current topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer accessible for scientific study.

When palaeontological mitigation is recommended, it may take place preceding construction or, more successfully, during the construction phase when new, potentially fossiliferous bedrock is exposed and available for study. Mitigation typically involves the careful sampling, collection and recording of fossils, as well as appropriate data regarding the immediate sedimentary matrix. Excavation of the fossil heritage will involve a permit from SAHRA and the material will have to be housed in a permitted institution. With proper mitigation, many developments comprising bedrock excavation will have a *positive* impact on our knowledge of local palaeontological heritage.

4 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed consolidation footprint of the Ilima Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup) (**Fig.4-5**); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits.

4.1 Geology

4.1.1 Dwyka Group

The Permo-Carboniferous Dwyka Group forms the lowermost and oldest deposit in the Karoo Supergroup. Dwyka deposits were deposited in a cold, glacially-dominated environment which occurred when South Africa lay below a massive ice sheet. The Dwyka Group comprises nearly throughout of gravelly sediments with subordinate vorved shale and mudstone consisting of scraped and facetted pebbles. Retreating glaciers deposited dark-grey tillite. The Dwyka Group is characterized by a rich assemblage of dropstones that vary in size.

4.1.2 Vryheid Formation

The Vryheid Formation consists mainly of light grey course-to fine grained sandstone and siltstone sediments. Dark coloured siltstones can be attributed to the occurrence of carbon enrichment and coal beds. Deltaic mudrocks and sandstones, coastal and fluvial deposits, and infrequent coal seams are present. The sediments most probably have been deposited on a sandy shoreline, beyond massive swamplands. Plant material accumulating within these swamps formed the coal deposits that are mined today (Johnson et al, 2006).

4.1.3 Karoo Dolerite Suite

The Karoo Dolerite Suite is a widespread network of undeveloped igneous bodies (dykes, sills) that were intruded into sediments of the Main Karoo Basin in the Early Jurassic Period (approximately 183 million years ago). These igneous rocks are unfossiliferous.

5 PALAEONTOLOGICAL HERITAGE

5.1 Dwyka Group

The Permo-Carboniferous Dwyka Group is characterized by track ways produced mostly by fish and arthropods (invertebrates), coprolites (fossilized faeces), body fossils of marine fish, gastropods and invertebrates as well as fossil plants including fossilized leaves, wood, spores and pollens.

5.2 Vryheid Formation

The Vryheid Formation of the Ecca Group is world renowned for the presence of coal beds which has been formed due to the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011) are; *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalensis*, *Annularia sp., Raniganjia sp., Asterotheca spp.*, *Liknopetalon enigmata*, *Glossopteris* more than 20 species, *Hirsutum 4 spp*., *Scutum 4 spp., Ottokaria 3 spp*., *Estcourtia sp.*, *Arberia 4 spp*., *Lidgetonnia sp*., *Noeggerathiopsis sp*. and *Podocarpidites s*p.

According to Bamford (2011) “Little data have been published on these potentially fossiliferous deposits. Around the coal mines there is most likely to be good material and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites, however, in the interests of heritage and science such sites should be well recorded, sampled and the fossils kept in a suitable institution”.

The Vryheid Formation is also well-known for its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, palaeoniscoid fish, small crustaceans, insects, trace fossils track ways, organic-walled spores and pollens as well as petrified wood. The mesosaurid reptile, *Mesosaurus* may also be present in the development site.

5.3 Quaternary Superficial Deposits

In the past the paleontology of the Quaternary superficial deposits has been fairly neglected. They may sporadically comprise important fossil biotas, e.g. bones, teeth and horn cores of mammals as well as reptiles. Non-marine molluscs, ostrich egg shells, trace fossils (calcretised termitaria, coprolites), and plant remains like peats, pollens and spores in organic-rich alluvial horizons and diatoms in pan sediments have also been uncovered. These fossil assemblages are generally rare, low in diversity, and occur over a wide geographic area.

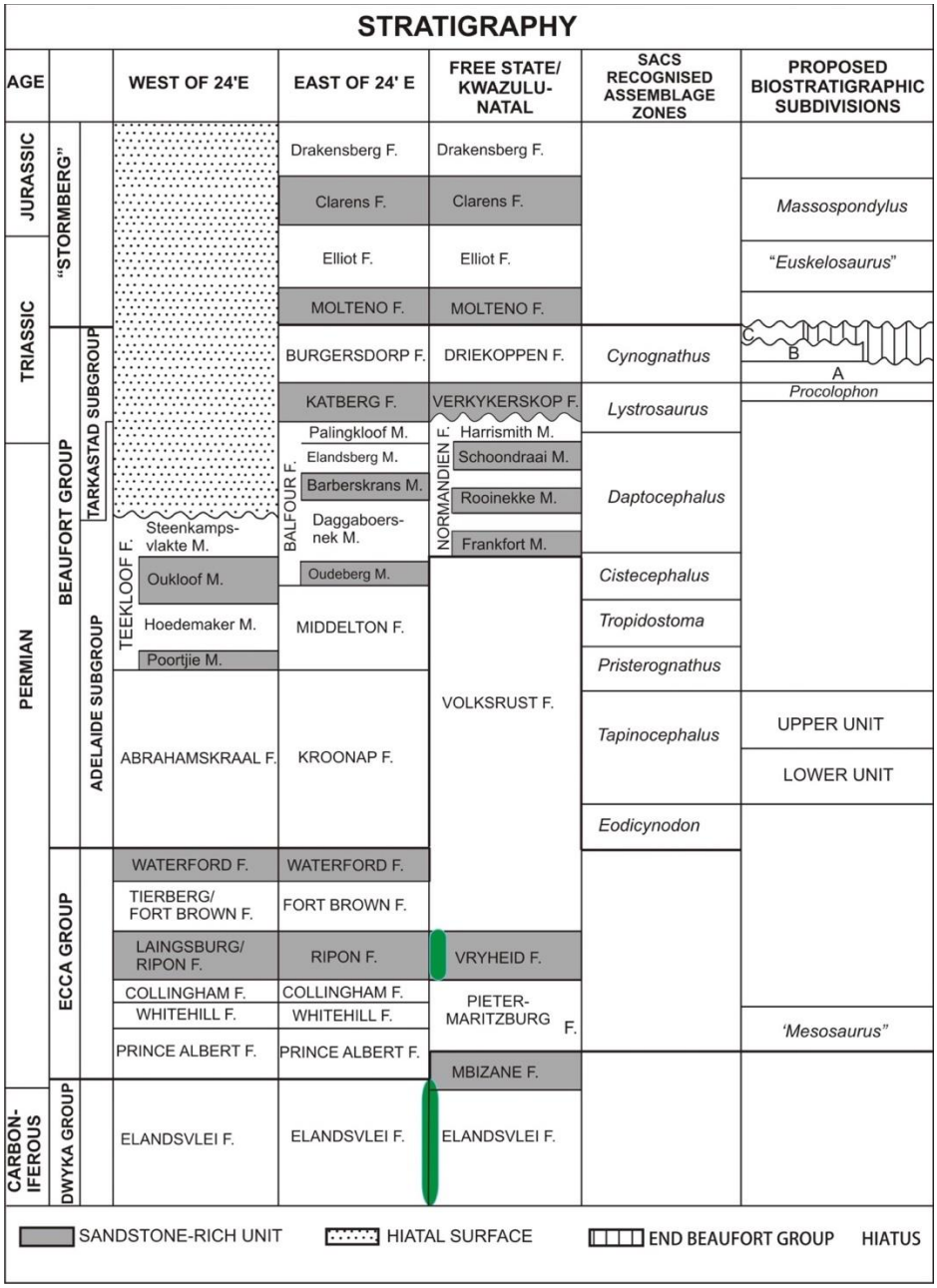

Figure 4: Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions of the Ecca and Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in green (Modified from Rubidge 1995). The subdivisions of the Ecca Group include the Vryheid and is Early Permian in age. Abbreviations: F. = Formation, M. = Member.

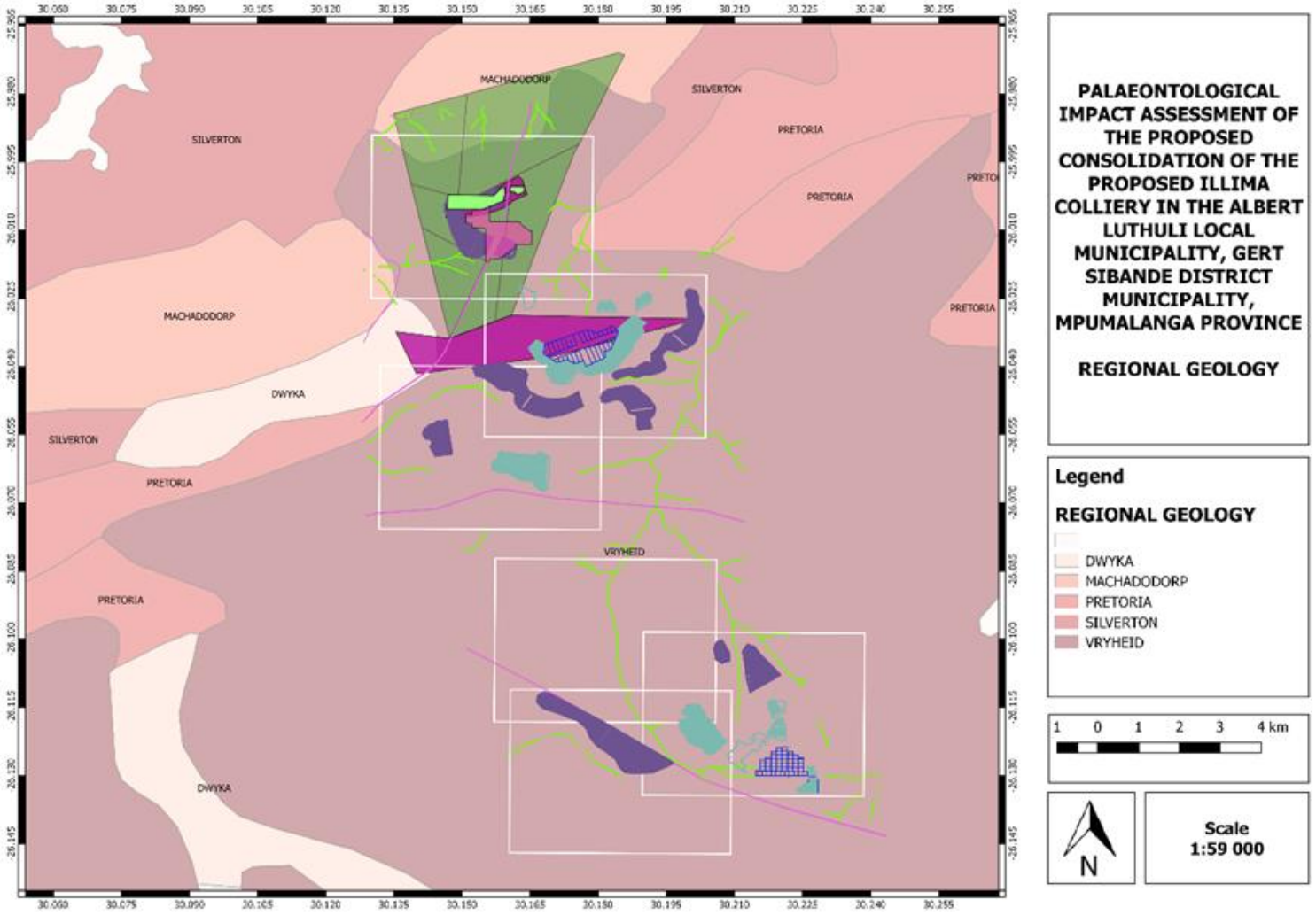

Figure 5: The surface geology of the proposed consolidation of the proposed Illima Colliery in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. The development site is completely underlain by by sedimentary rocks of the Permo-Carboniferous Dwyka Group); Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposit.

6 GEOGRAPHICAL LOCATION OF THE SITE

The Ilima Colliery is located east of Carolina, immediately north of the R38, in the Mpumalanga Province, South Africa. The Ilima Colliery is situated in the magisterial district of Carolina and falls under the Chief Albert Luthuli Local Municipality, situated in the Gert Sibande District Municipality (**Fig. 1, 2**).

7 METHODS

A palaeontological study was thus conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2015), topographical and geological maps and other reports from the same area were used to assess the proposed area of the development.

Coordinate	View of locality
26° 08"13'S; 30°13" 15'E	

Coordinate	View of locality
26° 07”17’S; 30°13” 08’E	
26° 03”51’S; 30°07” 47’E	

Coordinate	View of locality
26° 00”50’S; 30°07” 52’E	
26° 00”05’S; 30°09” 20’E	

Coordinate	View of locality
26° 00”47’S; 30°09” 27’E	
26° 01”42’S; 30°11” 167’E	

Coordinate	View of locality
Opening to the underground mine on the farm Zandvoort 10, Ilima Colliery, in Mpumalanga, South Africa	
Sediments (mudstone) at the opening of the underground mine on the farm Zandvoort 10, Ilima Colliery, in Mpumalanga, South Africa.	

Coordinate	View of locality
The opencast mining operations on the farm Kwaggafontein 8 IT, Ilima Colliery, in Mpumalanga, South Africa.	

8 ASSUMPTIONS AND LIMITATIONS

The accuracy and dependability of PIA as part of HIAs are normally limited by the following:

- Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists and most development study areas have never been surveyed by a palaeontologist.
- The correctness of geological maps where data may be based merely on aerial photographs and small areas of important geology have been ignored. The sheet explanations for geological maps are insufficient and little to no attention is paid to the palaeontology.
- Impact assessments and other reports - is not readily available for desktop studies.

Large areas of South Africa have not been studied palaeontologically. Fossil data assembled from similar Assemblage Zones but in different areas, might provide insight on the possible presence of fossils in an unfamiliar area. Desktop studies thus assume the presence of unexposed fossil heritage within study areas of similar geological formations. When significant exposures of bedrocks or potentially fossiliferous superficial sediments are present in the development area, the trustworthiness of a Palaeontological Impact Assessment may be enhanced through a field-survey by a professional palaeontologist.

9 IMPACT ASSESSMENT

Impacts from mining are rated as medium significance (**Table 14**).

Table 16 - Assessment of impact of mining on palaeontological resources

Impact Name	**Destruction of palaeontology**				
Alternative	**All Alternatives**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	1	2	Reversibility of Impact	3	1
Duration of Impact	5	5	Probability	3	1
Environmental Risk (Pre-mitigation)					-9.00
Mitigation Measures					
It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase. In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations, the ECO in charge for these developments ought to be informed immediately. Such discoveries must be protected (preferably *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to ensure that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist					
Environmental Risk (Post-mitigation)					-2.50
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.50
Final Significance					-3.75

10 FINDINGS AND RECOMMENDATIONS

The proposed consolidation footprint of the Ilima Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group,

Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits.

The Permo-Carboniferous Dwyka Group forms the lowermost and oldest deposit in the Karoo Supergroup. This Group is characterized by the presence of trace fossils (track ways, coprolites), body fossils of marine fish, gastropods and invertebrates as well as fossil plants. The rocks of the Dwyka are of low palaeontological sensitivity. The Vryheid Formation of the Ecca Group is world renowned for the occurrence of coal beds which has been formed due to the accumulation of plant material over long periods of time. Trace fossils as well as fish, small crustaceans, insects, as well as petrified wood and spores and pollens are common in this Formation. The sedimentary rocks of the Vryheid Formation have a very high palaeontological sensitivity. The Dolerite of the Jurassic has a very low palaeontological sensitivity as these rocks are unfossiliferous. The fossil assemblages of the Quaternary deposits (low palaeontological sensitivity) are usually rare, low in diversity, and occur over a wide geographic area. The fossil heritage of Quaternary deposits may sometimes contain important fossil biotas.

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. Regardless of the rare and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific significance as many fossil taxa are known from a single fossil.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations, the ECO in charge for these developments should be informed immediately. Such discoveries must be protected (preferably *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to ensure that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

The specialist would need a collection permit from SAHRA. Fossil material ought to be curated in an approved collection (*e.g.* museum or university) and all fieldwork and reports ought to meet the minimum standards for palaeontological impact studies developed by SAHRA.

Recommendations:

1. The EAP and ECO for the Ilima Colliery ought to be informed that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains. The fossils are mostly trace fossil and plant fossil assemblages.
2. A qualified palaeontologist must be employed to evaluate and record fossils at the development footprint. The fossils may be placed on a stockpile where a professional palaeontologist may inspect them at regular intervals (determined by the mine and palaeontologist).
3. These recommendations ought to form part of the EMP of the Ilima Colliery mining project.

11 REFERENCES

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12 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty three years. She has been conducting Palaeontological Impact Assessments since 2014.

13 DECLARATION OF INDEPENDENCE

I, Elize Butler, declare that –

General declaration:

- *I act as the independent palaeontological specialist in this application*
- *I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant*
- *I declare that there are no circumstances that may compromise my objectivity in performing such work;*
- *I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, Regulations and all other applicable legislation;*
- *I will take into account, to the extent possible, the matters listed in section 38 of the NHRA 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 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;*
- *I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and*

- *I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.*

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 Regulations;*

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SIGNATURE: