HERITAGE IMPACT ASSESSMENT

Proposed establishment of the Krone-Endora Diamond Mine on a Portion of the Farm Krone 104MS and a Portion of the Farm Endora66 MS near Alldays in the Limpopo Province.

Prepared By:

G & A Heritage
Heritage Management Consultants

For

EcoPartners

Credit Sheet

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Disclaimer; Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. G&A Heritage and its personnel will not be held liable for such oversights or for costs incurred as a result of such oversights.

Statement of Independence

As the duly appointed representative of G&A Heritage, I Stephan Gaigher, hereby confirm my independence as a specialist and declare that neither I nor G&A Heritage have any interests, be it business or otherwise, in any proposed activity, application or appeal in respect of which the Environmental Consultant was appointed as Environmental Assessment Practitioner, other than fair remuneration for work performed on this project.

Signed off by S. Gaigher

Site name and location: Proposed establishment of the Krone-Endora Diamond Mine on a Portion of the farm Krone as well as a Portion of the Farm Endora 66MS adjacent to Venetia Mine near Alldays, Limpopo Province.

Municipal Area: Vhembe District Municipality.

Developer: DMI Minerals South Africa (Pty) Ltd.

Consultant: G&A Heritage, PO Box 522, Louis Trichardt, 0920, South Africa. 38A Voster Str. Louis Trichardt, 0920

Date of Report: 14 May 2012

Management Summary

The purpose of the management summary is to distil the information contained in the report into a format that can be used to give specific results quickly and facilitate management decisions. It is not the purpose of the management summary to repeat in shortened format all the information contained in the report, but rather to give a statement of results for decision making purposes.

This study focuses on the development of the proposed DMI Minerals South Africa (Pty) Ltd (DMI Minerals) Krone-Endora Diamond mine. The site will impact on an area of +/- 666 ha of the farms and is therefore subjected to a Mining Rights Application and its associated specialists' studies.

The purpose of the Heritage Impact Assessment (HIA) phase of the study is to determine the possible occurrence of sites with cultural heritage significance within the study area and the evaluation of the heritage significance of these sites as well as the possible impacts on such sites by the proposed development.

Findings

Although the mining right licence application will be submitted for an area of 666ha it was indicated by mine management that far less than this would be directly impacted and less than 120ha would be impacted within the first 7 to 10 years.

The area under investigation falls on the outside perimeter of the Mapungubwe World Heritage Site and Cultural Landscape. One area with significant Middle- to Late Stone Age deposit was identified.

The Paleontological Impact Assessment (PIA) indicated the possible occurrence of fossils within this area.

Recommendations
It is recommended that a surface collection of the Stone Age tools be conducted before mining initiates.

Specific monitoring and paleontological material unearthed by the mining activity is recommended by the PIA.

Fatal Flaws
No fatal flaws were identified.

Contents

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List of Abbreviations

Bp	Before Present
EIA	Early Iron Age
ESA	Early Stone Age
GPS	Geographic Positioning System
HIA	Heritage Impact Assessment
LIA	Late Iron Age
LSA	Late Stone Age
MYA	Million Years Ago
MSA	Middle Stone Age
NHRA	National Heritage Resources Act no 22 of 1999
PIA	Paleontological Impact Assessment
SAHRA	South African Heritage Resource Agency
S&EIR	Scoping & Environmental Impact Reporting
Um	Micrometre (10^{-6} m)
WGS	84World Geodetic System for 1984
WHS	World Heritage Site

Glossary

Acheulean

The name given to an archaeological industry of stone tool manufacture associated with early humans during the Lower Palaeolithic era across Africa and much of West Asia, South Asia and Europe. Acheulean tools are typically found with Homo erectus remains.

Lithics

Lithic artifacts include ground and chipped stone tools and the debris resulting from their manufacture.

Knappers

People or persons involved in the shaping of flint, chert, obsidian or other fracturing stone through the process of lithic reduction to manufacture stone tools.

Bifaces

Hand axes that may be oval, triangular, or almond-shaped in form and characterized by axial symmetry, even if marks made by use are more plentiful on one face.

Sangoan

Sub-Saharan African stone tool industry of Acheulean derivation dating from about 130000 to 10000 years ago.

Fauresmith

A sub-Saharan African stone tool industry dating from about 75000 to 100000 years ago named for the town close to where the first sites were identified.

Assemblages

An assemblage is an archaeological term meaning a group of different artifacts found in association with one another, that is, in the same context.

Heritage Impact Report for the Proposed DMI Minerals Krone-Endora Diamond Mine

Introduction

Background Information
Krone-Endora Diamond Mine

Project Description
DMI Minerals, a BEE company jointly owned by broaded-based BEE women's group Nozala Investments, and Canadian listed Diamcor Mining is proposing the development of the Krone-Endora Diamond Mine on a Portion of the Farm Krone 104MS as well as a Portion of the Farm Endora 66MS in the Limpopo Province. The mining right application is for a surface area of +/- 666 Ha, however due to the concentrated nature of the proposed mining activity it is only anticipated that the mine will impact on less than 400 Ha of surface area within the 666 Ha. The mine will focus on processing the alluvial gravels which eroded off the Venetia Kimberlite Pipes. Prospecting and Bulk sampling rights have already been obtained for the study area and both DMI Minerals and DeBeers Consolidated Mines have performed a significant amount of prospecting work in sampling in the study area over a period of more that 2 decades. The initial mining area of 122 Ha has been fenced off.

Site Location
The proposed development site is located on a 666 Ha located on a Portion of the Farm Endora 66MS as well as a Portion of the Farm Krone 104MS, near Alldays in the Limpopo Province. This farm is located directly north of the De Beers' Venetia Diamond mine.

Figure 1. Present Landscape (Mopane Bushveld)

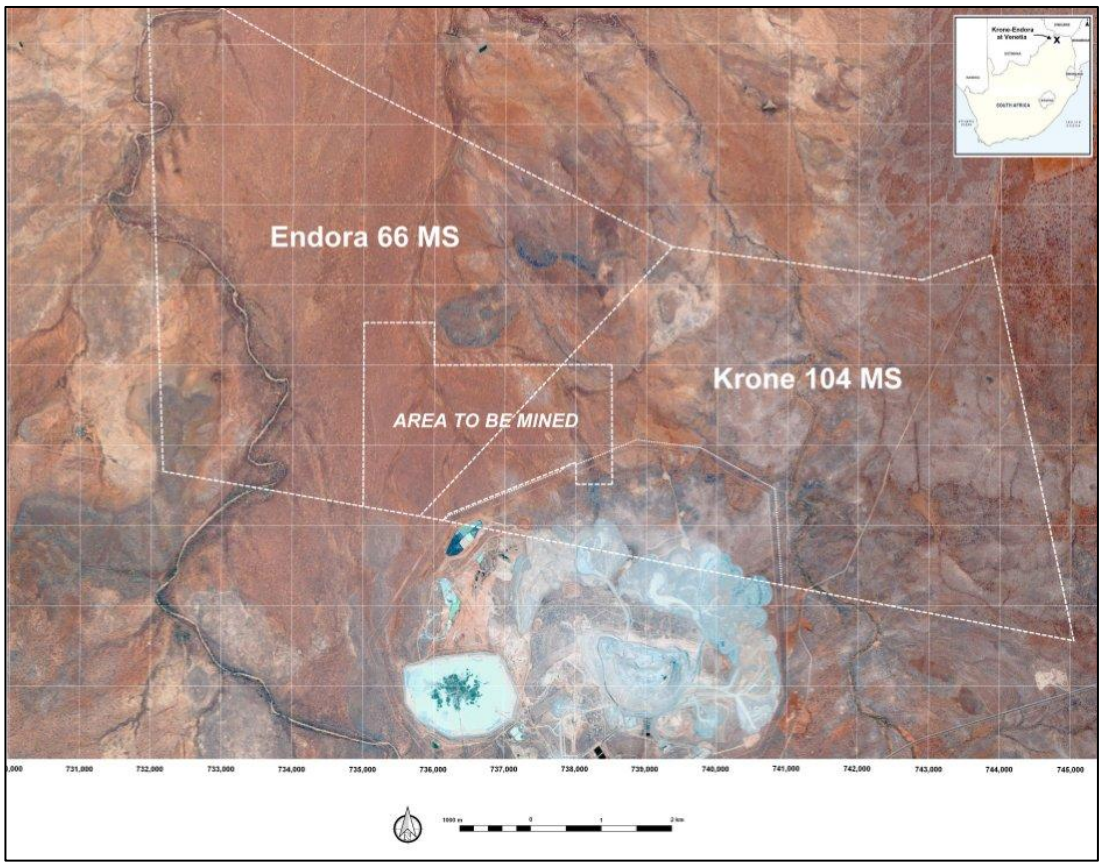

Figure 2. Aerial View of Study Area

Alternatives Considered.
No alternatives were considered.

Methodology
This study defines the heritage component of the Mining Right Application process being undertaken for the Proposed Krone-Endora Diamond Mine. It is described as a Heritage Impact Assessment. This report attempts to evaluate the accumulated heritage knowledge of the area as well as the heritage sensitivity of proposed development areas.

Evaluating Heritage Impacts
The HIA relies on the analysis of written documents, maps, aerial photographs and other archival sources combined with the results of site investigations and interviews with effected people. Site investigations are not exhaustive and often focus on areas such as river confluence areas, elevated sites or occupational ruins.

The following documents were consulted in this study;
- South African National Archive Documents
- SAHRA Database of Heritage Studies
- Mapungubwe World Heritage Visitors Centre
- Internet Search
- Historic Maps
- 1936 and 1952 Surveyor General Topographic Map series
- 1952 1:10 000 aerial photo survey
- Google Earth 2011 & 2003 imagery
- Published articles and books
- JSTOR Article Archive

Assumptions and Restrictions
- It is assumed that the SAHRA database locations are correct
- It is assumed that the social impact assessment and public participation process of the Mining Right Application phase will result in the identification of any intangible sites of heritage potential.

Heritage Indicators within the Receiving Environment
Regional Cultural Context

Stone Age
The Stone Age sites of this area fit within the later Earlier Stone Age and the Middle Stone Age periods, and this section therefore discusses the relevant industries, beginning with the Acheulean. The rate of change seen in the lithics of the Acheulean is slow (Klein 2000), but by the later Acheulean, knappers were familiar with a more extensive range of options which become more refined in the MSA, such as the prepared core technique and blade production (Barham 2000, Beaumont & Vogel 2006). The transition from the end of the Acheulean to the MSA is complex and controversial and has been described as the most important event to occur in the later Middle Pleistocene (Tryon 2006). Traditionally the disappearance of handaxes and cleavers has defined the MSA in South Africa. In other words, when the large cutting tools of the Acheulean seem to be replaced with points of bone or stone, industries are attributed to the MSA. However, early MSA sites are very rare and this paucity of information tends to exaggerate the differences between the Acheulean and the MSA.

In the past, a number of researchers have recognized industries that are 'transitional' between the ESA and MSA. At the 1955 Panafrican Congress the term 'First Intermediate Period' was adopted to describe this transition period between the ESA and MSA (McBrearty 1988). The term was then dropped at the Burg Wartenstein symposium of 1965 due to

insufficient field evidence. However, a number of researchers still support the argument for transitional industries, and these are discussed in the sections below.

Therefore while the ESA with bifaces generally gives way to an MSA without bifaces, in some areas 'transitional' industries' defined as the Sangoan and Fauresmith have been recognized. This 'transitional' status has meant that the Sangoan is frequently referred to as a final ESA industry (Clark 1959), but some researchers consider it to represent the early MSA (Davies 1976, Van Peer *et al.* 2003). Van Riet Lowe (1947) placed the Fauresmith at the end of the ESA, while Beaumont & Vogel (2006) define the Fauresmith as the MSA, arguing that it is older than 500,000 years old. More recently a number of researchers have again been researching these industries (e.g., M. Chazan, F. Rheinhardt), and they argue that while they are problematic, they do in fact exist (McBrearty 1988). Although no good dates are available for the Sangoan, it seems to appear at approximately 300,000 years ago and is associated with the appearance of more evolved hominids (McBrearty 1988, White *et al.* 2003). The variation seen in artefacts at this time is complex and although the terms Sangoan and Fauresmith are the traditional industry names for this period, actually pigeonholing assemblages within these industries is difficult.

Iron Age

The Early Iron Age is the best represented in this area with several Late Iron Age to be found as well. The Mapungubwe and K2 sites (approximately 20km north of the mining site) are the best known of the Early Iron Age sites. Sites that are culturally related to K2 and Mapungubwe have been observed on Hamilton 41 MS, Samaria 28 MS and Den Staat 27 MS. Another site related to Mapungubwe was excavated by Van Ewyk (1987) on Skutwater to the east of Greefswald. Small Iron Age sites postdating Mapungubwe and K2 have been recorded on Greefswald, including some stone-walled sites on hilltops.

Figure 3. Mapungubwe Hill

Some of these sites have been identified by T.N. Huffman as Khami type ruins. According to oral tradition, communities belonging to the Lea and Twamamba tribes, related to the Venda and the Shona-speaking people, settled in the Greefswald region in historical times.

They were followed, after c. AD 1700, by Sotho-speaking people. The seasonal presence of tsetse fly in the Lowveld during the 19th century made cattle herding difficult for the Iron Age communities (Fuller 1923). Malaria made living conditions still worse. As a result, the Greefswald area was used only for hunting from around 1900 until after the 1920s. When

gold was discovered in stone-walled sites north of the Limpopo River, prospectors and treasure hunters began to search for similar sites south of the Limpopo River.

The Origins of Mapungubwe Project (WITS Phase)
Since the 1990s, Wits archaeologists have worked in the Mapungubwe landscape investigating Stone Age, Rock Art and Iron Age sites. They concentrated on the last 2000 years. The systematic survey of the National Park and buffer zone, including Little Muck, Schroda and Venetia, has now recorded some 1000 Iron Age sites. Using this data, various graduate students have investigated ethnic stratification (Calabrese PhD 2005), glass beads and international trade (Wood MA 2005), the ethno-archaeology (Murimbika PhD 2006) and archaeology (Schoeman PhD 2006) of rainmaking, the relationship of settlements to the landscape (du Piesanie MSc 2008), faunal remains (Fatherley MSc 2009), agricultural production (Chandler Honours 2009) and spherulites in cattle dung. Current research includes settlements during the Khami Period (du Piesanie PhD) and herding strategies.

Although the survey has not included either the Krone or Endora properties, they have been investigating neighboring properties and the results of site location patterns were useful in this study.

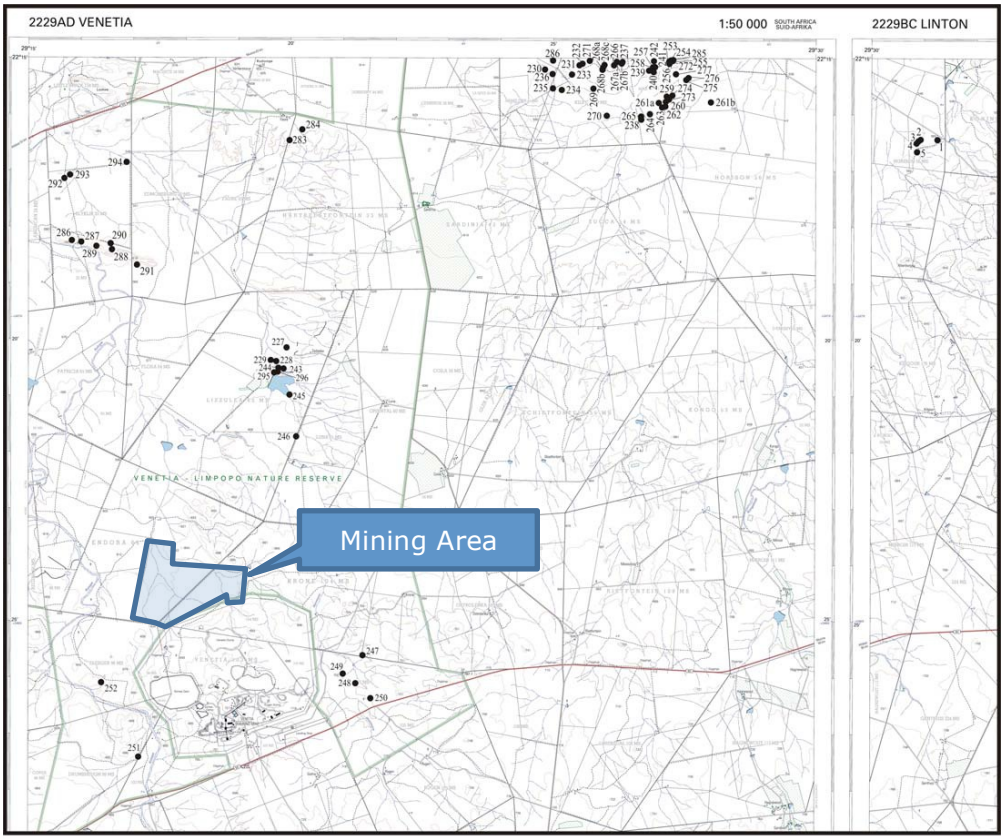

Figure 4. Results of the 2008 Season

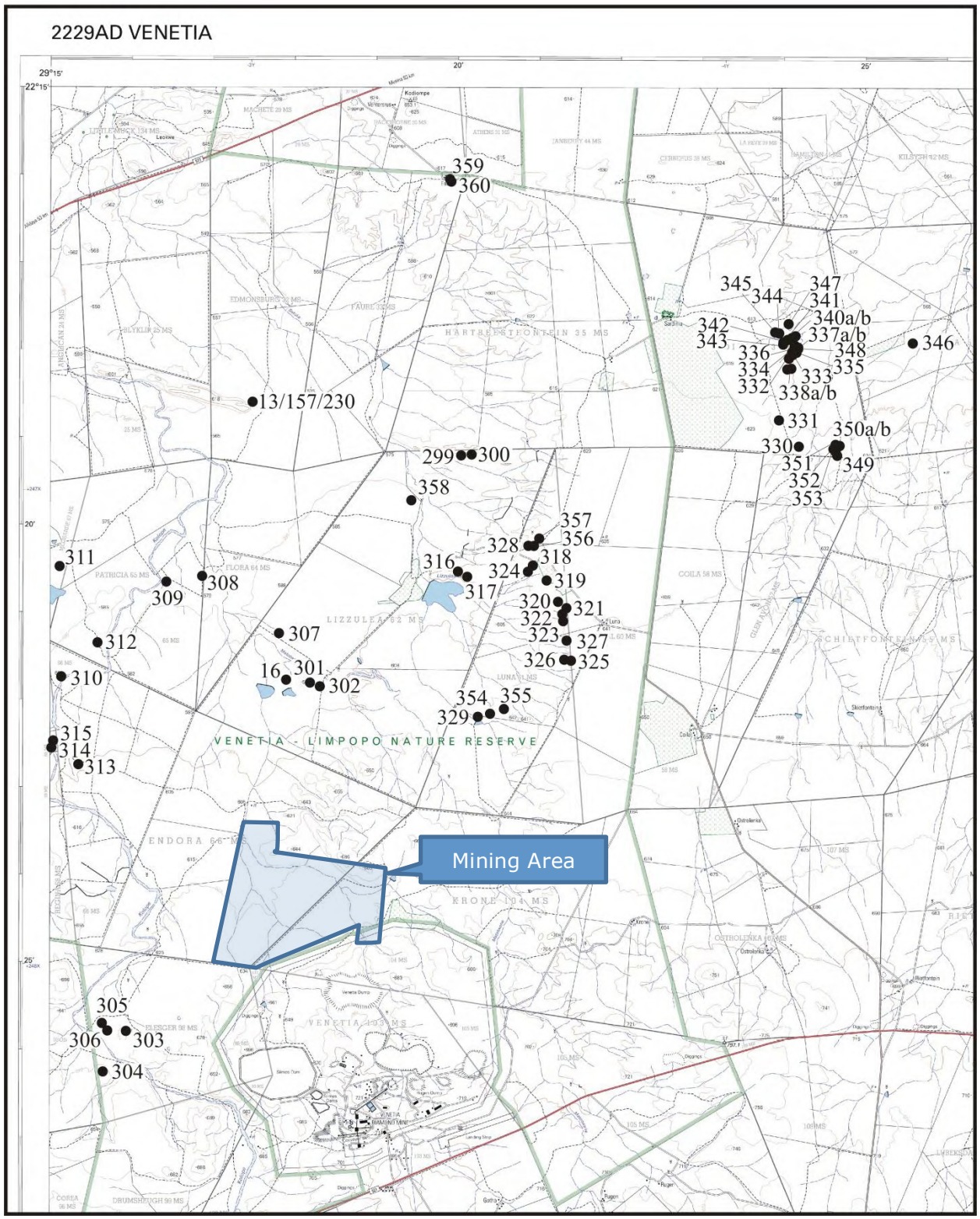

Figure 5. Results of the 2009 – 2010 Season

It is significant to note that documented sites were clustered along riverbeds or other sources of water or around elevated areas.
The study area does not exhibit these characteristics within the section indicated by the mining management as the area that would be affected.

The Historic Era

"Mapungubwe was the largest settlement in the subcontinent in the 13th century AD before it was abandoned. Various communities settled in the vicinity over the next 600 years. Legends and rumours about the place were passed on from generation to generation. Karel Moerschell, a local German farmer, knew about the gold by 1911, but it was not until the 1930s that the significance of Mapungubwe became more widely known.

On 31 December 1932, a local informant, Mowena, led E.S.J. van Graan, and four others to Greefswald farm on Mapungubwe Hill where they saw stone walls and recovered gold and iron artefacts, pottery and glass beads. The finds, which received wide publicity in the media, were reported to the head of the Department of History at the University of Pretoria, Professor Leo Fouché. As a result of his intervention, the University negotiated with the owner of the property, E.E. Collins.

In a legal agreement the University took ownership of the gold and other artefacts and secured an option and contract for excavation rights. The University also successfully requested a postponement of prospecting, mining and related activities on Greefswald. In June 1933, Greefswald was bought by the Government and excavation rights were granted to the University of Pretoria.

The University established an Archaeological Committee, which from 1933 to 1947 oversaw research and excavations. Rev. Neville Jones from Zimbabwe and J.F. Schofield were appointed to undertake the first fieldwork in 1934 and 1935 and they were advised by Professor C van Riet Lowe, Director of the Bureau of Archaeology. Their work focused on Mapungubwe Hill, the southern terrace and the midden there. They briefly surveyed other similar sites in the vicinity.

From 1935-1940 six excavation seasons at K2 and Mapungubwe Hill were directed by Guy A. Gardner. The results of his work were published nearly 25 years later. Meyer (1998) describes the excavations on Greefswald between 1933 and 1940 as 'rapid, large scale excavations resulting in the recovery of valuable artefacts'. Research was hampered by 'the lack of professional archaeologists in South Africa, the lack of full-time supervision of the excavations by efficient, trained staff, the fact that adequate scientific methods for Iron Age research had not yet been developed and that the Iron Age in South Africa was virtually unknown to archaeologists. Consequently, many of the deposits on the sites were removed without the meticulous excavation and recording required. These problems inevitably resulted in a loss of irreplaceable deposits and eventually also of excavated materials [and] a lack of scientific data.'

The next phase of archaeological investigation, in 1953- 1954 and in 1968-1970, under the direction initially of the Department of Anthropology, and then of Professor J F Eloff who was appointed as Head of the newly-formed Department of Archaeology at the University of Pretoria in 1970, was more systematic and focused mainly on the southern terrace.

Over the next 25 years from 1970 to 1995, the Department of Archaeology at the University of Pretoria recognised that their first priority was to establish a firm database by testing, correcting and supplementing the earlier research, and concentrating on reconstructing the way of life of the site inhabitants. Between 1979 and 2002 reports have been published on the human and faunal remains, Chinese porcelain, gold objects, glass beads and radiocarbon dating.

In addition, sites on neighbouring farms have been investigated by students of the University of Pretoria during the 1970s and 1980s.

Greefswald has remained the property of the State since the 1930s. Management of the farm was taken over by the provincial Department of Nature Conservation in 1992, and control was transferred to SANParks in 1999.

The aim is for SANParks eventually to acquire all the land within the proposed park or to have contractual agreement with the owners. This will allow the land to be taken out of agriculture and revert to 'natural' landscape. A chart of the current progress with land negotiations is included in the nomination. Currently there are 'in principle' agreements for 11 of the remaining 29 land units (making up the conservation area of the Mapungubwe National Park), but the timetable is missing. These are currently used for different purposes: some are being cultivated using irrigation agricultural techniques based on water extracted from the Limpopo river, some are managed as game reserves, and others are owned by the De Beers Corporation and are used to ensure water extraction, storage, and provision for that organization's diamond mining activities, which are estimated to have a maximum working life of twenty years." (http://whc.unesco.org/pg.cfm?cid=31&id_site=1099)

The Tshivhula are recognised today as the senior dynasty of the Twamamba, a western Venda group established in the Limpopo Province before the 17th century arrival of the Singo, the present royalty. The Machete line, on the other hand, is a minor division of the Tshivhula community. Van Warmelo (Van Warmelo, 1940) recorded Twamamba and Machete traditions in 1939 because of their potential association with the then newly-discovered deposits on Mapungubwe Hill. According to these traditions, the Tshivhula headquarters in the 18th century was located near the saltpan at the west end of the Soutpansberg. A son of chief Tshivhula, Raletaupe, was sent to the Limpopo as a district leader sometime in the 1830s. He found Bolana (a Birwa headman) and Thaha (a Kalanga chief) living at Leokwe Hill. This well-known hill, excavated by John Calabrese for his PhD, is now on the farm Little Muck inside the Mapungubwe National Park and 18km north of the study area.

There are two settlements on the Leokwe ridge adjacent to Little Muck. The one on the west end, excavated by Calabrese, overlooks the Kolope River (2229AD1). This west settlement was sited on top of an earlier rainmaking place. The west end then was the most favoured location, and it was probably occupied first by the chief Thaha. Presumably, the Birwa occupied the hut terraces at the base of the hill.

Bolana and the Birwa are something of an enigma. Traditionally, they are said to have originated to the east near present-day Tzaneen. They moved from there to Tauyatswala, establishing a new Bobirwa west of the Blouberg (Van Schalkwyk's 1994). Excavations near Tauyatswala yielded Letaba pottery from a Birwa settlement that incorporated rudimentary stonewalling built between boulders at the back. In the Mapungubwe area, two similar settlements lay along the southwest base of Leokwe Hill. Other rough terracing probably marks Birwa settlements previously identified as Venda. (Huffman, 2009 a).

Cultural Landscape

The most prominent cultural landscape identified is the Mapungubwe World Heritage Site and Cultural Landscape. The study area lies on the southern edge of the buffer zone for this area, however it is still recommended that the possible impacts on it be evaluated.

The following landscape types could possibly be present in the study area.

Landscape Type	Description	Occurrence still possible?	Likely occurrence?
1 Paleontological	Mostly fossil remains. Remains include microbial fossils such as found in Baberton Greenstones	Yes, sub-surface	Unlikely
2 Archaeological	Evidence of human occupation associated with the following phases – Early-, Middle-, Late Stone Age, Early-, Late Iron Age, Pre-Contact Sites, Post-Contact Sites	Yes	Unlikely

3 Historic Built Environment	- Historical townscapes/streetscapes - Historical structures; i.e. older than 60 years - Formal public spaces - Formally declared urban conservation areas - Places associated with social identity/displacement	No	No
4 Historic Farmland	These possess distinctive patterns of settlement and historical features such as: - Historical farm yards - Historical farm workers villages/settlements - Irrigation furrows - Tree alignments and groupings - Historical routes and pathways - Distinctive types of planting - Distinctive architecture of cultivation e.g. planting blocks, trellising, terracing, ornamental planting.	No	No
5 Historic rural town	- Historic mission settlements - Historic townscapes	No	No
6 Pristine natural landscape	- Historical patterns of access to a natural amenity - Formally proclaimed nature reserves - Evidence of pre-colonial occupation - Scenic resources, e.g. view corridors, viewing sites, visual edges, visual linkages - Historical structures/settlements older than 60 years - Pre-colonial or historical burial sites - Geological sites of cultural significance.	Yes	Unlikely
7 Relic Landscape	- Past farming settlements - Past industrial sites - Places of isolation related to attitudes to medical treatment - Battle sites - Sites of displacement,	Yes	Unlikely
8 Burial grounds and grave sites	- Pre-colonial burials (marked or unmarked, known or unknown) - Historical graves (marked or unmarked, known or unknown) - Graves of victims of conflict - Human remains (older than 100 years) - Associated burial goods (older than 100 years) - Burial architecture (older than 60 years)	Yes	Unlikely
9 Associated Landscapes	- Sites associated with living heritage e.g. initiation sites, harvesting of natural resources for traditional medicinal purposes - Sites associated with displacement & contestation	No	No

	- Sites of political conflict/struggle - Sites associated with an historic event/person - Sites associated with public memory		
10 Historical Farmyard	- Setting of the yard and its context - Composition of structures - Historical/architectural value of individual structures - Tree alignments - Views to and from - Axial relationships - System of enclosure, e.g. defining walls - Systems of water reticulation and irrigation, e.g. furrows - Sites associated with slavery and farm labour - Colonial period archaeology	Yes	No
11 Historic institutions	- Historical prisons - Hospital sites - Historical school/reformatory sites - Military bases	Yes	Unlikely
12 Scenic visual	- Scenic routes	Yes	Mapungubwe Cultural Landscape
13 Amenity landscape	- View sheds - View points - Views to and from - Gateway conditions - Distinctive representative landscape conditions - Scenic corridors	No	No

The Mapungubwe Cultural Landscape in Terms of this Project

The Mapungubwe Conservation Area includes the areas under the administration of the Venetia Mine and especially its nature reserve. Much of the areas now included in in the Mapungubwe National Park were once under the management and protection of the Venetia Conservation Society and are in fact still owned by the DeBeers group. These areas are being managed as natural areas around the central mining area of the Venetia mine itself. In itself it serves as a buffer zone for the industrial activities at the mine and the recently formed Mapungubwe National Park.

"A buffer zone serves to provide an additional layer of protection to a World Heritage property. The concept of a buffer zone was first included in the Operational Guidelines for the implementation of the World Heritage Convention in 1977. In the most current version of the Operational Guidelines of 2005 the inclusion of a buffer zone into a nomination of a site to the World Heritage List is strongly recommended but not mandatory." (http://whc.unesco.org/en/events/473).

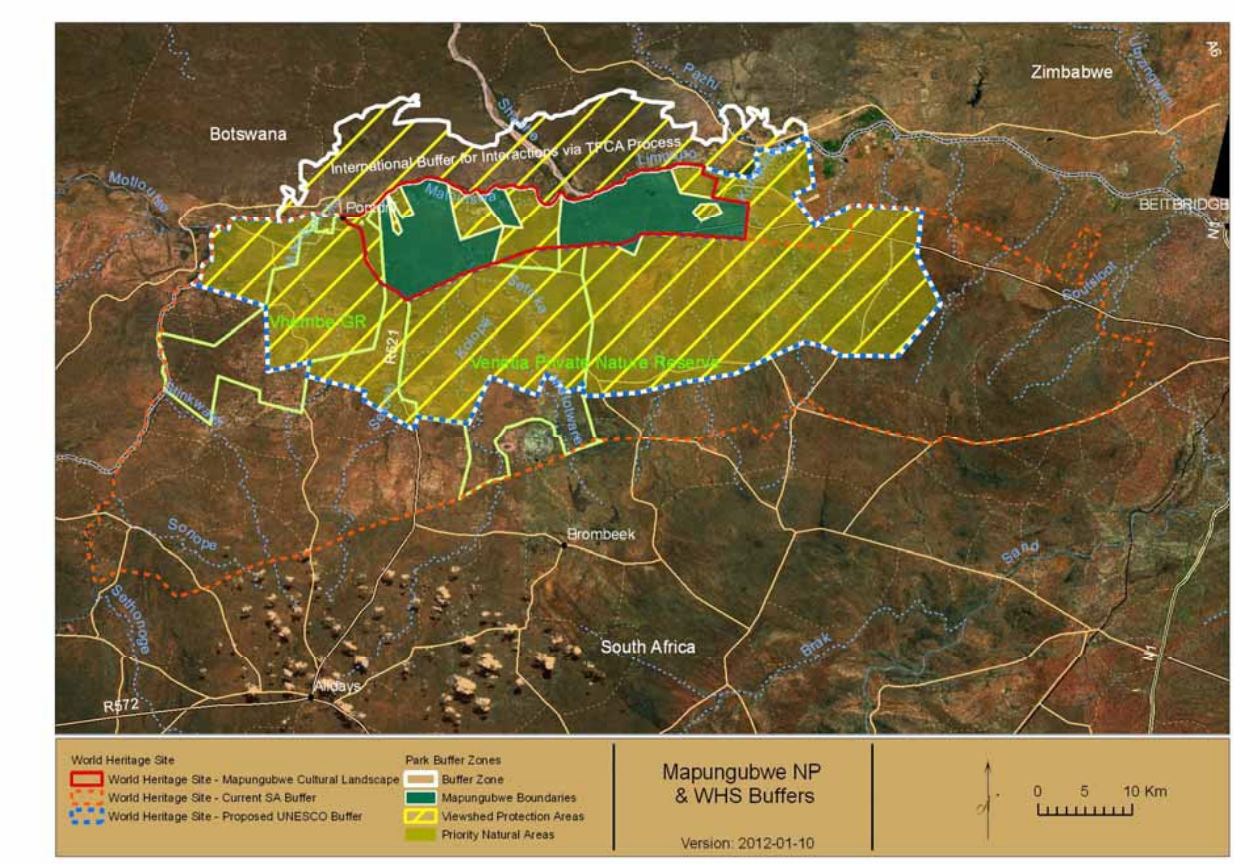

Figure 6. Location of the Mapungubwe Park and WHS buffer zones

The red line in the above map shows the extent of the Mapungubwe WHS.

The activities described in this report is concentrated and limited to areas outside of the proposed buffer zone of the Mapungubwe World Heritage Site. This means that the boundaries of the Mapungubwe Cultural Node (as defined in the World Heritage Site application) are around 30km away from the proposed activity. Secondary impacts such as visual, dust and noise impacts will be mitigated in part by the Environmental Management Plan Report but also in a large part by the distance from these sites of the proposed activities.

"Many World Heritage properties face problems that directly or indirectly derive from the situation of their buffer zone. New constructions within a buffer zone may have an impact on the World Heritage property and could threaten its Outstanding Universal Value; a different legal status of a buffer zone could also impact the conservation, the protection or management plan of a site." (http://whc.unesco.org/en/events/473)

Sites Recorded
Site 1

GPS 22.41000° S
29.31422° E

This is a surface scatter of Middle(MSA)- to Late Stone Age tools, cores and flakes. Although the concentration of material is not high, all the indicators of a manufacturing site are found here and it is anticipated that a more intensive surface collection will result in larger collections. The surface finds were scattered over an area of around 30 x 30m in the south-eastern corner of the study area.

Figure 7. Surface scatter of Stone Tools at Site 1

Goodwin (Goodwin and Van Riet Lowe, 1929) characterized MSA artifacts as technically "in some ways intermediate between the Earlier and Later Stone Age methods," with artifacts made on flakes and no true core tools. In contrast to the Later Stone Age, MSA artifacts had faceted, rather than flat, striking platforms, and the flakes tended to have convergent, rather than parallel, dorsal scars, which resulted in "the typical implement throughout the Middle Stone Age Industries [being] the worked point in a variety of forms" (Goodwin and Van Riet Lowe, 1929, p. 98). This description, however, belies the typological variety of MSA stone artifact assemblages, and subsequent researchers (e.g., Mason, 1962, 1967; Sampson, 1968, 1972; Volman 1981, 1984) used the term in a less restricted sense to include any flake- and/or blade dominated assemblages stratigraphically between Earlier and Later Stone Age collections (Klein, 1970).

The correlation between the collected artifacts and the above descriptions are illustrated by the following photographs of collected tools and cores;

Figure 8. Examples of Stone Age Tools

Figure 9. Aerial view showing location of Site 1

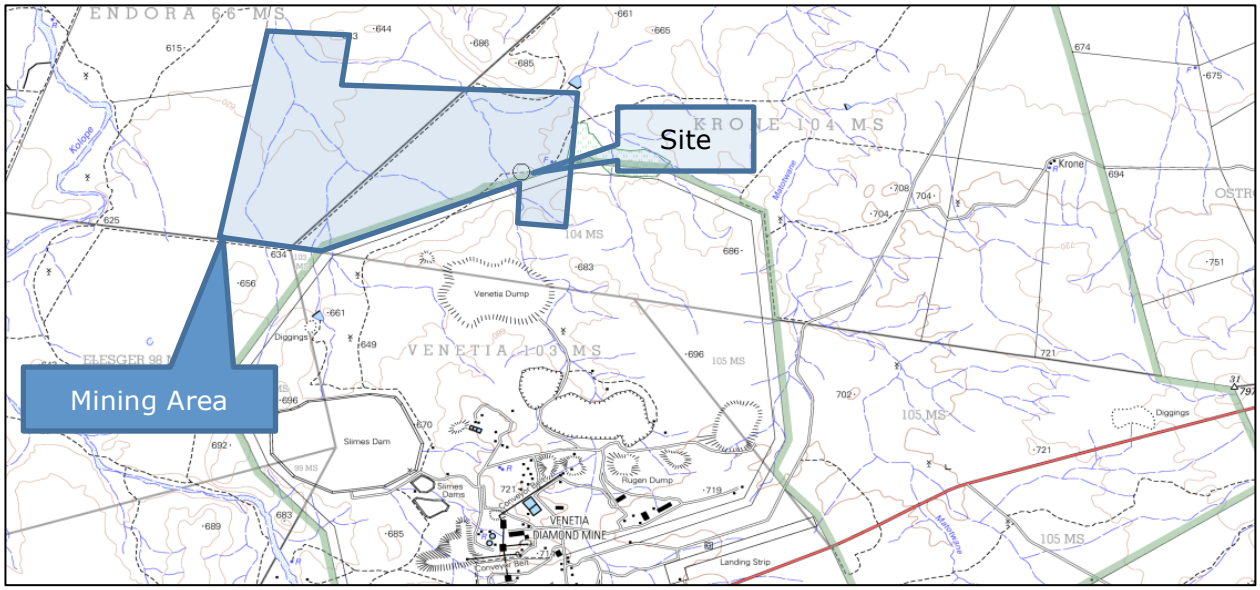

Figure 10, Location of Sit 1

Heritage Environments that will be affected

Archaeological Sites - Pre-Contact Heritage (Stone Age Sites)

Nature of Impacts: The proposed development activities could negatively affect sites associated with the Stone Age.

Extent of Impacts: Localized damage to the sites (see *Impact Statement* section for application).

Nature of Impact: Possible post-contact site could be damaged locally by excavation activities and associated activities		
	Without Mitigation	With Mitigation
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Long term (5)**

Magnitude	**Medium (8)**	**Low (1)**
Probability	**Highly Probable (4)**	**Improbable (1)**
Significance	**Medium (56)**	**Low (8)**
Status	**Negative**	**Positive**
Reversibility	**Irreversible**	**Irreversible**
Irreplaceable loss of resource	**Yes**	**No**
Can impacts be mitigated	**No**	**Yes**
Mitigation	**Surface collection of Stone Age Tools before mining commences**	
Cumulative impacts	**None**	
Residual impacts	**Loss of heritage related information**	

Paleontological sites
Nature of Impacts: The Paleontological Impact Assessment (PIA) performed for this study (See Addendum B) indicated the possible occurrence of fossil deposits within the study area. These could be negatively affected by the mining activities.

Extent of Impact: Localized damage to paleontological sites.

Nature of Impact: Paleontological sites will be uncovered during mining activities.		
	Without Mitigation	With Mitigation
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (5)**	**Long term (5)**
Magnitude	**High (8)**	**Low (1)**
Probability	**Probable (4)**	**Improbable (1)**
Significance	**Medium (60)**	**Low (8)**
Status	**Negative**	**Positive**
Reversibility	**Irreversible**	**Reversible**
Irreplaceable loss of resource	**Yes**	**No**
Can impacts be mitigated	**No**	**Yes**
Mitigation	**Periodic paleontological monitoring and collection of material throughout the mining phase**	
Cumulative impacts	**None**	
Residual impacts	**Loss of paleontological information**	

Mitigation
Paleontological monitoring and collection during mining phase as per the PIA report.

Built Environment
Although some built structures were noted, none will be affected by the proposed development.

Nature of Impacts: No built environment sites were located within the study area.

Extent of Impact: No damage is anticipated as no sites were identified.

Mitigation
No sites were identified and therefore no mitigation is recommended.

Cultural Landscape
Several possible cultural landscape components were identified especially associated with the Mapungubwe WHS Cultural Landscape.

Nature of Impacts: The development of the mine could result in alterations to the cultural characteristics of the landscape.

Extent of Impact: Limited impacts on the cultural landscape are anticipated.

Nature of Impact: Limited impacts on the cultural landscape are anticipated.		
	Without Mitigation	With Mitigation
Extent	**Local (2)**	**Local (2)**
Duration	**Short term (2)**	**Long term (2)**
Magnitude	**Low (1)**	**Low (1)**
Probability	**Improbable (3)**	**Improbable (3)**
Significance	**Low (15)**	**Low (15)**
Status	**Positive**	**Positive**
Reversibility	**Reversible**	**Reversible**
Irreplaceable loss of resource	**No**	**No**
Can impacts be mitigated	**Yes**	**Yes**
Mitigation	**No further mitigation is recommended**	
Cumulative impacts	**None**	
Residual impacts	**None**	

Mitigation
No further mitigation is recommended.

Selection of alternatives
No alternatives were indicated.

Heritage Management Planning

Minimizing the Impact on Archaeological Sites (as per the NHRA)

Objective 1: Minimizing the impact on archaeological sites
The development of the mine could impact on sites of archaeological importance.

Project Component	Mine and related infrastructure
Potential Impact	Destruction archaeological sites
Activity/Risk source	Mining related excavations
Mitigation Target	Conserve archaeological sites

Mitigation: Action	Responsibility	Time Frame
Surface collection of Stone Age tools identified during the heritage investigation.	Contracting of a qualified heritage practitioner to perform collection.	Before mining commences.

Performance Indicator	No destruction of archaeological sites
Monitoring	No further monitoring of this site is needed

Minimizing the impact on the cultural landscape (as per the NHRA)

Objective 1: Minimizing the impact on the cultural landscape
The proposed site lies inside of the southern boundary of the buffer zone for the Mapungubwe WHS and Cultural Landscape. Possible impacts on this landscape type should be avoided.

Project Component	Mining activities

Potential Impact	Negative impacts on the cultural landscape
Activity/Risk source	Mining activities
Mitigation Target	Preservation of cultural landscape components

Mitigation: Action	Responsibility	Time Frame
Mapungubwe WHS management should be informed of the development and any changes in the buffer zone should be re-evaluated.	Environmental Manager	Continuous

Performance Indicator	No impact on Mapungubwe WHS and Cultural Landscape
Monitoring	Throughout mining phase

Minimizing the impact on Unidentified Sites (as per the NHRA)

Objective 1: Minimizing the impact on unidentified sites
Unidentified or sub-surface sites could still be encountered during the mining phase

Project Component	Mining activities
Potential Impact	Destruction of unidentified sites
Activity/Risk source	Mining
Mitigation Target	Minimize impact on unidentified sites

Mitigation: Action	Responsibility	Time Frame
Monitoring of excavation activities during the mining phase of the project.	Contracted heritage practitioner	During mining phase. Once every two weeks for the first year and then once a month for the next two years.

Performance Indicator	No destruction of archaeological sites
Monitoring	Monitoring during mining phase

Minimizing the impact on Burial and Grave Sites (as per the NHRA)

Objective 1: Minimizing the impact on burial and grave sites
The mining activities could impact on unidentified burial or grave sites

Project Component	Mining activities
Potential Impact	Destruction of grave and burial sites
Activity/Risk source	Mining
Mitigation Target	Mitigate impacts on burial or grave sites

Mitigation: Action	Responsibility	Time Frame
On uncovering a possible grave or burial site it is imperative that construction be ceased immediately. The area should be marked and a heritage practitioner should be informed immediately.	Environmental control officer	Immediately

Performance Indicator	Mitigation of burial and grave sites
Monitoring	No monitoring is required

Conclusion
The area investigated for the Mining Rights and License application is located within a sensitive cultural landscape. With the close proximity of the Mapungubwe World Heritage Site and the recent negative image of mining in the area it was necessary to conduct an exhaustive and comprehensive investigation into the heritage sensitivity of the proposed mining area.

The proposed mining area showed signs of Stone Age occupation and stone tool manufacture. Although this site was identified it was of limited scientific value and can be mitigated. The mitigation will involve a surface collection of artifacts before the mining activity commences as well as subsequent monitoring of the mining activity.

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Appendix A

Impacts anticipated

Impacts Anticipated

In 2003 the SAHRA compiled the following guidelines to evaluate the cultural significance of individual heritage resources:

TYPE OF RESOURCE

- Place
- Archaeological Site
- Structure
- Grave
- Paleontological Feature
- Geological Feature

TYPE OF SIGNIFICANCE

1. HISTORIC VALUE

   It is important in the community, or pattern of history
   - Important in the evolution of cultural landscapes and settlement patterns
   - Important in exhibiting density, richness or diversity of cultural features illustrating the human occupation and evolution of the nation, province, region or locality.
   - Important for association with events, developments or cultural phases that have had a significant role in the human occupation and evolution of the nation, province, region or community.
   - Important as an example for technical, creative, design or artistic excellence, innovation or achievement in a particular period.

It has strong or special association with the life or work of a person, group or organisation of importance in history
   - Importance for close associations with individuals, groups or organisations whose life, works or activities have been significant within the history of the nation, province, region or community.

It has significance relating to the history of slavery
   - Importance for a direct link to the history of slavery in South Africa.

2. AESTHETIC VALUE

   It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group.
   - Important to a community for aesthetic characteristics held in high esteem or otherwise valued by the community.
   - Importance for its creative, design or artistic excellence, innovation or achievement.
   - Importance for its contribution to the aesthetic values of the setting demonstrated by a landmark quality or having impact on important vistas or otherwise contributing to the identified aesthetic qualities of the cultural environs or the natural landscape within which it is located.
   - In the case of an historic precinct, importance for the aesthetic character created by the individual components which collectively form a significant streetscape, townscape or cultural environment.

3. SCIENTIFIC VALUE

It has potential to yield information that will contribute to an understanding of natural or cultural heritage
   - Importance for information contributing to a wider understanding of natural or cultural history by virtue of its use as a research site, teaching site, type locality, reference or benchmark site.
   - Importance for information contributing to a wider understanding of the origin of the universe or of the development of the earth.

- Importance for information contributing to a wider understanding of the origin of life; the development of plant or animal species, or the biological or cultural development of hominid or human species.
- Importance for its potential to yield information contributing to a wider understanding of the history of human occupation of the nation, Province, region or locality.
- It is important in demonstrating a high degree of creative or technical achievement at a particular period
- Importance for its technical innovation or achievement.

4. SOCIAL VALUE
   - It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons
   - Importance as a place highly valued by a community or cultural group for reasons of social, cultural, religious, spiritual, symbolic, aesthetic or educational associations.
   - Importance in contributing to a community's sense of place.

DEGREES OF SIGNIFICANCE

1. RARITY

It possesses uncommon, rare or endangered aspects of natural or cultural heritage.

- Importance for rare, endangered or uncommon structures, landscapes or phenomena.

2. REPRESENTIVITY
   - It is important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects.
   - Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class.
   - Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.

The table below illustrates how a site's heritage significance is determined

Spheres of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific Community			

What other similar sites may be compared to this site?

Impact Statement

Assessment of Impacts

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase are assessed in terms of the following criteria:

- The nature, which shall include a description of what causes the effect, what will be affected and how it will be affected.

- The extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The duration, wherein it will be indicated whether:

- the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
- the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
- medium-term (5–15 years) – assigned a score of 3;
- long term (> 15 years) - assigned a score of 4; or
- permanent - assigned a score of 5;

- The magnitude, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The probability of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

- The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and

- The status, which will be described as either positive, negative or neutral.

- The degree to which the impact can be reversed.

- The degree to which the impact may cause irreplaceable loss of resources.

- The degree to which the impact can be mitigated.

The significance is calculated by combining the criteria in the following formula:

S = (E+D+M)P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The significance weightings for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),

- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),

- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

APPENDIX B

Legislation & Methodology

Legislation and methodology

G&A Heritage was appointed by EcoPartners to undertake a heritage impact assessment for the proposed Krone-Endora Diamond Mine on a Portion of the farm Krone 104MS and a Portion of the farm Endora 66MS in the Limpopo Province. Section 27(1) of the South African Heritage Resources Act (25 of 1999) requires that a heritage study is undertaken for:

(a) construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
(b) construction of a bridge or similar structure exceeding 50 m in length; and
(c) any development, or other activity which will change the character of an area of land, or water –

(1) exceeding 10 000 m^2 in extent;
(2) involving three or more existing erven or subdivisions thereof; or
(3) involving three or more erven, or subdivisions thereof, which have been consolidated within the past five years; or

(d) the costs of which will exceed a sum set in terms of regulations; or
(e) any other category of development provided for in regulations.

A heritage impact assessment is not limited to archaeological artefacts, historical buildings and graves. It is far more encompassing and includes intangible and invisible resources such as places, oral traditions and rituals as well as living heritage. A heritage resource is defined as any place or object of cultural significance i.e. of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This includes the following:

(a) places, buildings, structures and equipment;
(b) places to which oral traditions are attached or which are associated with living heritage;
(c) historical settlements and townscapes;
(d) landscapes and natural features;
(e) geological sites of scientific or cultural importance;
(f) archaeological and paleontological sites;
(g) graves and burial grounds, including –
(1) ancestral graves,

(2) royal graves and graves of traditional leaders,
(3) graves of victims of conflict (iv) graves of important individuals,
(4) historical graves and cemeteries older than 60 years, and
(5) other human remains which are not covered under the Human Tissues Act, 1983 (Act No.65 of 1983 as amended);

(h) movable objects, including ;

(1) objects recovered from the soil or waters of South Africa including archaeological and paleontological objects and material, meteorites and rare geological specimens;
(2) ethnographic art and objects;
(3) military objects;
(4) objects of decorative art;
(5) objects of fine art;
(6) objects of scientific or technological interest;
(7) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings; and
(8) any other prescribed categories, but excluding any object made by a living person;

(i) battlefields;
(j) traditional building techniques.

A '**place**' is defined as:
(a) A site, area or region;

(b) A building or other structure (which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure);
(c) a group of buildings or other structures (which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures); and (d) an open space, including a public square, street or park; and in relation to the management of a place, includes the immediate surroundings of a place.

'**Structures**' means any building, works, device, or other facility made by people and which is fixed to land and any fixtures, fittings and equipment associated therewith older than 60 years.

'Archaeological' means:
(a) material remains resulting from human activity which are in a state of disuse and are in or on land and are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;
(b) rock art, being a 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 is older than 100 years including any area within 10 m of such representation; and
(c) wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land or in the maritime cultural zone referred to in section 5 of the Maritime Zones Act 1994 (Act 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which are older than 60 years or which in terms of national legislation are considered to be worthy of conservation;
(d) features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found.

'Paleontological' means 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.

'Grave' means a place of interment and includes the contents, headstone or other marker of and any other structures on or associated with such place. The South African Heritage Resources Agency (SAHRA) will only issue a permit for the alteration of a grave if it is satisfied that every reasonable effort has been made to contact and obtain permission from the families concerned.

The removal of graves is subject to the following procedures as outlined by the SAHRA:

- Notification of the impending removals (using English, Afrikaans and local language media and notices at the grave site);
- Consultation with individuals or communities related or known to the deceased;
- Satisfactory arrangements for the curation of human remains and / or headstones in a museum, where applicable;
- Procurement of a permit from the SAHRA;
- Appropriate arrangements for the exhumation (preferably by a suitably trained archaeologist) and re-interment (sometimes by a registered undertaker, in a formally proclaimed cemetery);
- Observation of rituals or ceremonies required by the families.

The limitations and assumptions associated with this scoping study are as follows;
- Field investigations were hampered in areas with heavy plant growth.
- Sites were evaluated by means of description of the cultural landscape and analysis of written sources and available databases as well as field investigations.
- It was assumed that the site location as provided by EcoPartners is accurate.
- We assumed that the public participation process performed as part of the Scoping and Environmental Impact Reporting (S&EIR) process will be sufficiently encompassing not to be repeated in this phase.

Table 1. Impacts on the NHRA Sections

Act	Section	Description	Possible Impact	Action
National Heritage Resources Act (NHRA)	34	Preservation of buildings older than 60 years	No impact	None
	35	Archaeological, paleontological and meteor sites	Yes	Surface collection, Paleontological monitoring
	36	Graves and burial sites	Possible Impact	HIA
	37	Protection of public monuments	No impact	None
	38	Does activity trigger a HIA?	Yes	HIA

Table 2. NHRA Triggers

Action Trigger	Yes/No	Description
Construction of a road, wall, power line, pipeline, canal or other linear form of development or barrier exceeding 300m in length.	Yes	Various access roads and fences
Construction of a bridge or similar structure exceeding 50m in length.	No	N/A
Development exceeding 5000 m^2	Yes	Krone-Endora Mine
Development involving more than 3 erven or sub divisions	No	N/A
Development involving more than 3 erven or sub divisions that have been consolidated in the past 5 years	No	N/A
Re-zoning of site exceeding 10 000 m^2	No	N/A
Any other development category, public open space, squares, parks or recreational grounds	No	N/A

Proposed diamond mine adjacent to Venetia Mine, Limpopo Province

SCOPING REPORT
PALAEONTOLOGY

Compiled by: Dr JF Durand (Sci.Nat.)

For:
G&A Heritage
18 May 2012

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1. Introduction

The purpose of this document is to detail the probability of finding fossils in the study area and whether, if indeed there are fossils, what the impact of the mining activities will be on the fossils and fossil sites.

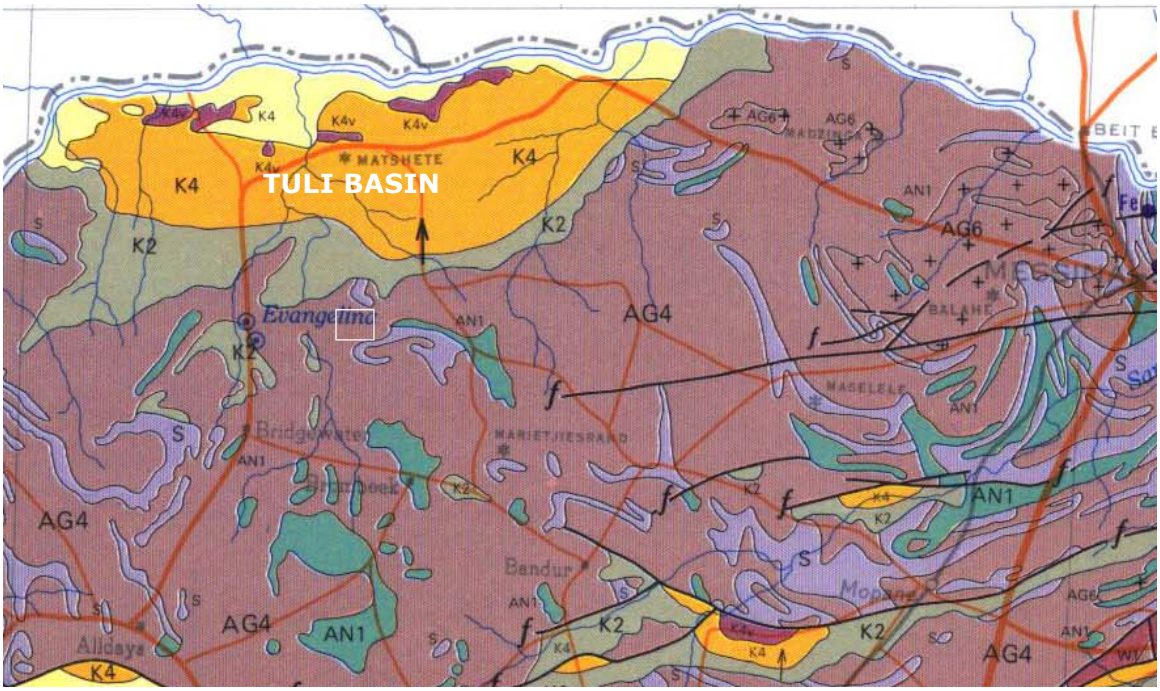
The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in *inter alia* the origin of dinosaurs, mammals and humans. Fossils are also used to identify rock strata and determine the geological context of the subregion with other continents and played a crucial role in the discovery of Gondwanaland and the formulation of the theory of plate tectonics.

Fossils and palaeontological sites are protected by law in South Africa. Construction and mining in fossiliferous areas may be mitigated in exceptional cases but there is a protocol to be followed.

South Africa has the longest record of palaeontological endeavour in Africa. South Africa was even one of the first countries in the world in which museums displayed fossils and palaeontologists studied earth history. It follows logically that South African palaeontological institutions would be world renowned, the fossil collections would be vast and the Heritage Act would be one of the most sophisticated and best considered in the world.

This is a Scoping Report which was prepared in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an initial assessment where the palaeontologist evaluates the scope of the project and as part of the assessment process gives an overview of the literature on the palaeontology and associated geology of the area. Although no publications which mention palaeontological studies that were done in the study area, several palaeontological studies were done on the areas to the north and south of the study site (De Jager 1983, Kovacs-Endrödy, 1983; Bordy & Catuneanu, 2002; Durand, 2005).

2. Broad description of the Geological formations found in the area



Legend

	Map description	Brandl, 2002	Main Karoo Basin equivalent
	Unconsolidated superficial deposits, conglomerate, marl, limestone, sandstone, high-level gravel		
K4v	Basalt, limburgite, pyroclasts, minor sandstone	Letaba Formation	Drakensberg Formation
K4	Sandstone, shale, mudstone, marl, coal	Clarens Formation	Clarens Formation
		Bosbokpoort Formation Klopperfontein Formation Solitude Formation	Elliot Formation equivalent (lithologies differ)
		Fripp Formation	Molteno Formation
K2	Shale, sandstone, grit, coal	Mikambeni Formation Madzaringwe Formation	Ecca Group
		Tshidzi Formation	Dwyka Group
AG4	Migmatite, gneiss, ultrametamorphic rocks	Limpopo belt of metamorphism and granitization	
AN1	Ultrabasic and basic intrusions and their metamorphic derivatives	Archaean complex	

Figure 1: Geological map of the Far North in the Limpopo Province indicating the locality of the study site (white block). Adapted from the 1: 1 000 000 Geology Map for South Africa, Lesotho and Swaziland, Geological Survey, 1970)

The Limpopo Metamorphic Belt which igneous and metamorphic rocks were overlain by Karoo sediments from approximately 240 million years ago. Subsequently, after the break-up of Gondwana, the Karoo layers were significantly reduced due to erosion which in places exposed the older non-fossiliferous rock strata as is the case in the study area. Some pockets of Karoo sediments which may be fossiliferous, remain to the south of the Tuli Basin.

The Main Karoo Basin, which covers more than 50 % of the surface of South Africa, can be subdivided into the Dwyka, Ecca and Beaufort Groups. The layers overlying the Beaufort Group can be subdivided into the Molteno, Elliot and Clarens Formations which are in turn overlain by the Drakensberg Basalts (Johnson *et al*., 1996).

In the northern part of the Limpopo Province and in Mpumalanga the Karoo Supergroup is much attenuated and incomplete compared to the Main Karoo Basin to the south. The Karoo-aged rocks occur mainly in two areas in the Limpopo Province named the Tuli and Tshipise Basins with minor outliers between them. The study area lies to the south of the Tuli Basin. The geology of the Tuli Basin is dominated by sedimentary rock with some occurrences of igneous rocks in the form of basalt and dolerite (see Figures 1, 3).

The sedimentary sequences of the Tuli Basin were set down on top of the Beit Bridge gneisses in a small intercratonic graben-type depression before the break up of Gondwanaland (Brandl, 2002). The basal Karoo sediments in the Tuli Basin, known as the Tshidzi Formation (Dwkya Group equivalent), consist of angular blocks and fragments derived mainly from much older underlying strata imbedded in coarse sand and grit. These diamictite deposits are overlain by channel deposits in the form of coarse reddish micaceous grits which pass upward into the laminated shale of the Madzaringwe Formation (Ecca Group equivalent).

The Madzaringwe Formation consists primarily of shales with occasional lenses of red and yellow grits in the lower sequences. Higher up in the sequence the shales alternate rhythmically with coal seams which constitute a 20 m thick coal zone. The model which best describes the processes responsible for such a sequence would be a marsh that was periodically flooded. If this model is correct the coal consists primarily from autochthonous plant material as would be suggested by the occurrence of root impressions and *Vertebraria* fossils (Van den Berg, 1980). The top of the Madzaringwe Formation is marked by point bar and channel-lag deposits forming a coarse micaceous sandstone layer which may be up to 10m thick (Brandl, 2002).

The Mikambeni Formation (Ecca Group equivalent) consists of shales and siltstones identical to those forming the Madzaringwe Formation. This 15m thick sequence was formed in a shallow lacustrine environment. This sequence contains carbonaceous shales and small coal seams in places. *Glossopteris* fossils are found in a buff-coloured siltstone unit near the top of the Mikambeni Formation (Brandl, 2002). The *Glossopteris* fossils indicate a Middle Ecca age (Kovacs-Endrödy, 1983).

It seems as if the Beaufort Group (Late Permian-Triassic) age strata are missing in the Karoo sedimentary sequence in the Limpopo Province (Van Zyl, 1950). The late Triassic to early Jurassic rocks therefore unconformably overlies the Ecca Group sedimentary rocks (Permian) in the Limpopo (Van den Berg, 1980).

The Fripp Formation which lies between the Mikambeni Formation and the overlying Solitude Formation consists of a 5-10 m thick coarse-grained layer of sandstone. The sand originated from strongly uplifted granitoid rocks and were set down as point bars and channel lag deposits. The Solitude Formation consists of siltstone which is typical of distal flood plain overbank and natural levee deposits. In the west it is up to 25m in thickness but attenuates to 3.5 m in the east (Brandl, 2002).

The Klopperfontein Formation separates the Solitude Formation and the overlying Bosbokpoort Formation for most of its extent. It consists of coarse-grained poorly sorted sandstone and grit with occasional conglomeratic horizons. This unit is characterised by trough cross-bedding. The grain size of the sediments and the sedimentary environment would suggest that this unit was formed during the continued upliftment of the hinterland, heavy erosion of the scarps during scarp formation and the proximal deposition of coarse sediments in fast running braided river systems (Brandl, 2002). This 10-12 m unit was identified as a local contemporary of the Molteno Formation of the Main Karoo Basin (De Jager, 1983).

The Bosbokpoort Formation consists of up to 60m of red to purple mudstones alternating with minor white siltstones in the upper half. The sedimentary environment is described as flood plains with meandering streams. A semi-arid climate would have caused the oxidization of the sediments, the formation of calcareous nodules and surface limestone (Brandl, 2002).

The 200m thick Bosbokpoort Formation is overlain by the Clarens Formation which has been subdivided into the Red Rocks Member and the Tshipise Member (McCourt & Brandl, 1980). The 20m thick Red Rocks Member consists mainly of white to red argillaceous sandstones deposited in distal flood-plain overbank and natural levees environments that are associated with mature meandering streams. A 5 m thick mudstone layer, identical to the mudstones in the Bosbokpoort Formation, near the top of this sequence contains prosauropod dinosaur bones. A 1-3 m thick calcareous layer containing fossil bone fragments underlies the Tshipise Member in places (Brandl, 2002).

The Tshipise Member which varies considerably in thickness (5-140m) abruptly overlies the Red Rocks Member. This member is characterised aeolian sand with large-scale cross-bedding typical of desert environments with barchan dunes with occasional water-deposited sediments associated with playa lakes. Ichnofossils have been found in this unit. The Letaba Formation, consisting of basaltic lavas overlies the Clarens Formation, marking the end of the Karoo sedimentation (Brandl, 2002).

3. Geological setting of the study area

The purpose of this section is not meant to be a report on the geology of the study area. For that a geological report is required from a specialist geologist. This intention of this section is to describe the geological setting for the palaeontology of the area within which the study site falls.

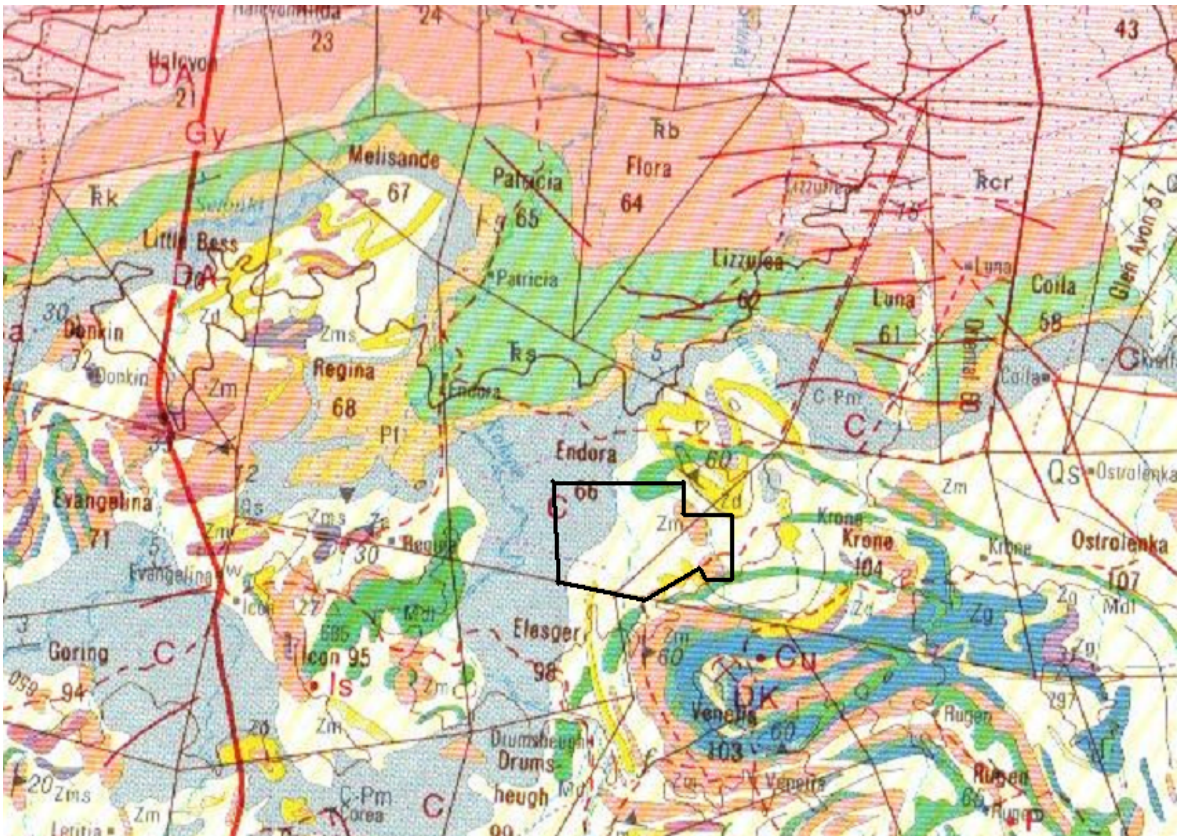
According to the 2228 ALLDAYS 1:250 000 Geology Map (Council for Geoscience, 2000) the study site is situated in an area dominated by migmatite, gneiss and

ultrametamorphic rocks of the Limpopo Metamorphic Belt and sediments of the Tuli Block of the Karoo Supergroup (Figure 2).

The Ecca Group is characterized by shale, mudstone, sandstone and seams of coal (Johnson, et al., 2006). In the Tuli Basin, the Ecca Group is represented by the Mikambeni and the Madzaringwe formations. The near horizontal layering of the geological strata and erosion of the adjacent and underlying rock strata results in a gently undulating landscape covered to a great extent by sandy soil. Exposures of the underlying geology are therefore exceptionally scarce in the Limpopo Province

Karoo and are mostly limited to gullies, river banks and road cuttings. However, when mining commences, large amounts of fossiliferous rock may be uncovered such as at the coal mines such as those in Mpumalanga and the Limpopo Province.

The Ecca Group of the Karoo Supergroup contain vast amounts of Permian leaf imprints of plants such as Glossopteris in places (Kovács-Endrödy, 1991). Millions of tons of fossiliferous material yielding mostly Glossopteris leaf imprints have been exposed at well studied sites in the northern rim of the main Karoo Basin such as Hammanskraal (Kovács-Endrödy, 1976), Witbank (Bamford, 2004) and Vereeniging (Rayner, 1986) and the ferromanganese mine at Ryedale (Pack et al., 2000).



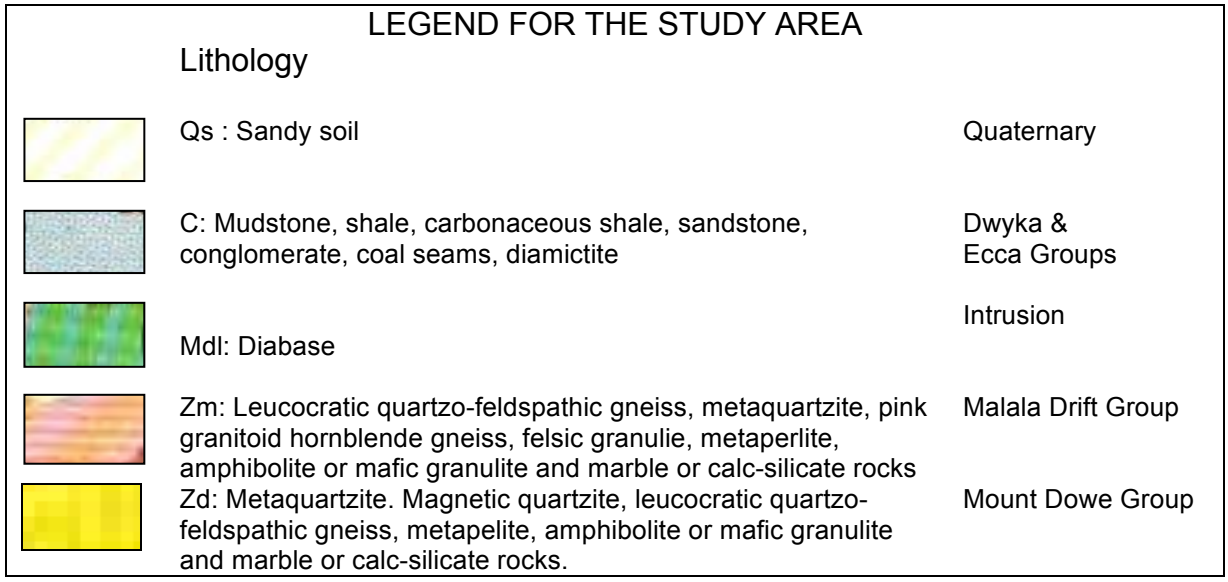


Figure 2: Geological map indicating the study site (adapted from the 2228 ALLDAYS 1:250 000 Geology Map, Council for Geoscience, 2000)

The fossilised leaf imprints are not found ubiquitously throughout the Ecca Group, but in pockets were the physical and chemical conditions during deposition resulted in the preservation of not only the structure of the leaves but also in some cases the organic material itself. The structure of the fossilised leaves is better preserved in the shales than in the sandstone units.

The study site (Figure 3) is mostly covered in sandy soils (Figure 3) and fossil localities are very scarce in this region. The plant fossil site on the grounds of the adjacent Venetia Mine yielded only very fragmentary fossils. This site, approximately 2km north of the study site, was however on the surface in a shallow gully and was exposed to the elements which would have contributed to its deteriorated state.

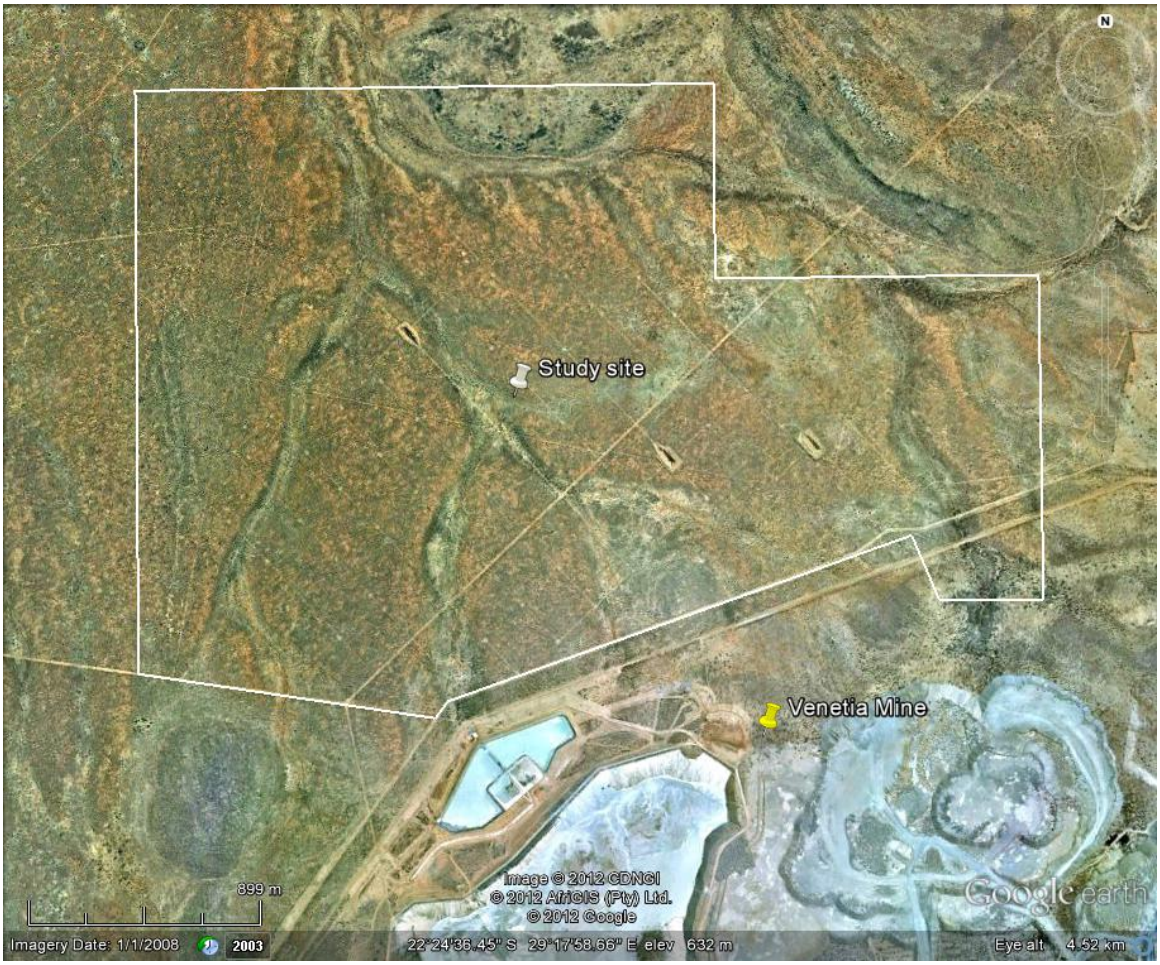


Figure 3: Google Earth view of the study site indicated with a white pin. The yellow pin indicate Venetia mine on the south eastern border of the study site

4. Palaeontology of the Tuli Basin

Although no published records of site locations of fossils in the study area exist, certain geological strata (i.e. the fossiliferous Madzaringwe and Mikambeni Formations of the Tuli Basin) that occur to the north of adjacent to the study area are known to be fossiliferous. The available literature shows that the Karoo strata of the Limpopo Province are exceptionally rich in fossils. Several palaeontological sites have been reported from the Tuli Basin in South Africa and Zimbabwe and from the Tshipise Basin (Van den Berg, 1980; Kovacs-Endrödy, 1983; Durand, 1996; 2001; 2005; Brandl, 2002).

These fossils fall mainly into two groups: firstly, the plant leaf imprints, stem fossils and coal from the lower part of the Karoo-age sedimentary succession (Middle Permian) and secondly, the dinosaur and thecodont fossils from the upper part (Late Triassic to Early Jurassic) of the Karoo-age sedimentary succession.

Fossil leaf imprints were found in the Tuli Basin sedimentary rocks on the Venetia mine grounds, to the east of the study area in the Tshipise Basin, and to the north of the study area in southern Zimbabwe. The fossils from the Tuli Basin are mainly leaf imprints of the extinct plant *Glossopteris*. (See Figure 4). However, stem imprints of the horsetail *Equisetales* and leaf imprints of ferns are also common. The fossil localities reported in the Tuli Basin are contemporaneous to those in the Tshipise Basin described by Van den Berg (1980) and studied by the author in the Njalaland section of the Kruger National Park, Tshikondeni Mine, Venetia Mine and the farm Nottingham in southern Zimbabwe. The species composition of the fossils and the lithologies of the palaeontological sites are similar in the Tuli and Tshipise Basins (Brandl, 2002).

The most recent taxonomic work on the Middle Permian fossil plants of the Tuli Basin was done by Kovacs-Endrödy in 1983 who identified 37 *Glossopteris* species from the Mikambeni Formation (Brandl, 2002).

Figure 4: Leaf imprint of *Glossopteris* (Middle Permian)

5. Legislation related to Palaeontology

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
- (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- (c) 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
- (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** 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 procedures in terms of section 38 has been followed, it may-
- (a) 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;
- (b) 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;
- (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- (d) recover the costs of such investigation form the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

6. Recommendations

Part of the mitigation will include the collection of fossils that may be exposed during mining in the western part of the study. In the unlike event of vertebrate fossils being found in this area, they would have to be salvaged due to their complexity, rarity and scientific importance.

Most of the geology in the study site is presently covered by alluvium consisting mainly of sandy soils and the bedrock will only be exposed during excavations during the mining process. If plant fossils are excavated during mining or construction it could simply be collected from the spoil heaps periodically by a qualified palaeontologist. For this reason it is important that a palaeontologist should visit the mine periodically in order to salvage representative and scientifically important fossils if necessary.

It is recommended that these fossils, if there are any, should be housed in an acknowledged repository such as the Council for Geoscience (CGS), Transvaal Museum or the Bernard Price Institute for Palaeontology.

7. Conclusion

The occurrence of geological strata with a palaeontological content in the region necessitates the inclusion palaeontology in the EIA of the study site. The relevant literature and research done by the author indicate that there could be fossils in the study site which may be encountered when construction and mining commences.

A qualified palaeontologist who is registered with SACNASP should be appointed to collect fossils if any are found during excavation.

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Higher Education Diploma (RAU), PhD Palaeontology (WITS)

Experience:
Palaeontological assessments:

- Urban development in the COHWHS: Letamo, Honingklip, Windgat, Sundowners, Ekutheni
- Urban development at Goose Bay, Vereeniging
- Upgrade of R21 between N12 and Hans Strydom Drive
- Vele Colliery, Limpopo Province
- De Wildt 50 MW Solar Power Station Gauteng
- 10 MW PV Plant Potchefstroom
- Omega 342 50MW Solar Power Station, Viljoenskroon
- Solar power plant, Bethal

Palaeontological research:

- Gauteng: Wonder Cave (COHWHS)
- KwaZulu/Natal: Newcastle, Mooi River, Rosetta, Impendle, Himeville Underberg, Polela & Howick Districts, Sani Pass
- Eastern Cape: Cradock District, Algoa Basin
- Western Cape: Clanwilliam District
- Free State: Memel & Warden Districts
- Limpopo Province: Nyalaland (KNP), Vhembe Reserve, Pont Drift
- Zimbabwe: Sentinel Ranch, Nottingham

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