SENDAWO PV POWER LINE CORRIDOR ALTERNATIVES

PROPOSED CONSTRUCTION OF THE POWER LINE AND COMMON COLLECTOR SUBSTATION AT THE SENDAWO SOLAR PHOTOVOLTAIC (PV) ENERGY FACILITY NEAR VRYBURG, NORTHWEST PROVINCE, CONNECTING TO THE MOOKODI MAIN TRANSMISSION SUBSTATION

Palaeontological Assessment Report

Issue Date: 21 July 2016
Revision No.: 3
Project No.: 13303

Date:	21 07 2016
Document Title:	Palaeontological Assessment Report
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Revision Number:	3
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For:	SiVEST Environmental Division

Executive Summary

PGS Heritage was appointed by SiVEST Environmental Division to undertake a Heritage Impact Assessment (HIA) Study that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of Sendawo Solar 75MW solar photovoltaic (PV) energy facilities near Vryburg, Northern Cape Province. This Palaeontological Impact Assessment report refers to the two alternative routes proposed for the construction of the Power Line from the Sendawo Substation to the Mookodi Main Transmission Substation and is compiled by Dr Gideon Groenewald, a qualified palaeontologist.

Palaeontological Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Heritage Scoping Report (Desktop PIA study) has shown that the proposed Sendawo Solar project will have palaeontological heritage resources present on the property. This has been confirmed through archival research and evaluation of aerial photography of the sites. Confirmation of actual presence of significant finds was confirmed during the fieldwork site visit to the development site for this project.

Evaluation of geological maps and satellite imagery has indicated the entire development area that may be sensitive from a Palaeontological perspective.

The fieldwork that covered the Sendawo Solar site as well as the proposed power line corridors covered the entire area with an evaluation field of 20 meters for small finds (10 meters either side of the palaeontologist) and 100 meters for larger finds such as possible sinkholes and cave breccias sites with tree growths (50 meters either side of the palaeontologist).

Find spots

Local scree material and blocks of dolomite were inspected for fossils and all finds were recorded as photographic records (Table 6). Outcrop of bedrock with significant stromatolites fossils was recorded and sites with potential cave breccia were recorded in areas where burrows of large vertebrates such as Aardvark were obviously present in the sandy deposits. Final identification of possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.

Mitigation:

- It is essential that the results of the Geotechnical Surveys be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites on all the proposed development areas;
- Field assessment indicated the presence of both significant stromatolite structures and possible cave breccia;

- If excavation of deeper than 1.5m is planned, the palaeontologist must assess the results of the geotechnical information and given the opportunity to comment on the likelihood of significant finds of fossils in all the planned development areas;
- If any excavation or collection of fossils is recommended, such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

Due to the presence of significant stromatolites in a small area and the large number of boulders with stromatolites present on site it is recommended that a palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. The aim being the identification and mitigation of any newly discovered palaeontological sites, if recorded. The significant finds recorded in Table 5 must lead to exclusion of the specific sites from this development.

Impact Summary

Table 1 provides a summary of the projected impact rating for this project on heritage resources.

Table 1: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Palaeontological resources	Impact during construction	-34	Very High Negative Impact	26	High Positive

Comparative Assessment for Sendawo Solar Development Power Line Routes

Table 2: Key to Preference of the two alternative routes for the power lines

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 3: Preference comparisons of the two alternative routes for the Sendawo power lines

Alternative	Preference	Reasons
POWER LINES		
Alternative 2A	No preference	Although stromatolites are present they are small and mostly associated with boulders on site
Alternative 2B	No preference	Although stromatolites are present they are small and mostly associated with boulders on site

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PALAEONTOLOGICAL HERITAGE ASSESSMENT REPORT

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1 INTRODUCTION

PGS Heritage was appointed by SiVEST Environmental Division to undertake a Heritage Impact Assessment (HIA) Study that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed development of Sendawo Solar 75MWsolar photovoltaic (PV) energy facilities south of Vryburg, Northwest Province. This Palaeontological Impact Assessment (PIA) report covering the proposed powerline and substation positions was commissioned by PGS Heritage and was completed by Dr Gideon Groenewald, an accredited Palaeontologist. . This PIA report refers to the two alternative routes proposed for the construction of the Power Line from the Sendawo Substation to the Mookodi Main Transmission Substation and is compiled by Dr Gideon Groenewald, a qualified palaeontologist.

1.1 Scope of the Study

The aim of the study is to identify possible palaeontological heritage sites, finds and sensitive areas that may occur in the study area for the EIA study. The Palaeontological Impact Assessment (PIA) aims to inform the Environmental Impact Assessment in the development of a comprehensive Environmental Management Plan to assist the developer in managing the discovered palaeontological 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

PGS Heritage (PGS) compiled this Heritage Impact Assessment Report.

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing the HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, Project manager for this project, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and has CRM accreditation within the said organisation, as well as being accredited as a Professional Heritage Practitioner with the Association of Professional Heritage Practitioners – Western Cape (APHP).

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African

Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years). Dr Groenewald was accompanied by Mr David Groenewald (BS Hons Palaeontology, Wits University) and experienced fieldworker.

1.3 Assumptions and Limitations

Not detracting in any way from the fieldwork undertaken, it is necessary to realise that the palaeontological heritage sites located during the fieldwork do not necessarily represent all the heritage sites present within the area. Should any heritage features or objects not included in the 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 that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to exposing of stromatolite structures as well as cave breccias.

The survey was conducted over 1 day and included the extent of the total footprint area by Dr Gideon Groenewald and David Groenewald on 18 February 2016. It must be stressed that the extent of the fieldwork was based on the available field time and was aimed at determining the palaeontological heritage character of the area.

The fieldwork that covered the Sendawo Solar site as well as the proposed power line corridors covered the whole area by vehicle and on foot, with specific observations recorded as a photographic database (Table 6). Detailed observation of outcrops were considered as highly important whereas loose gravel and boulders were recorded as representative examples of stromatolites structures which were out of situ observations. **Well defined stromatolites and a site with very high potential to be a cave breccia site were observed during the field investigation.**

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 Sections of these Acts relevant to heritage (Fourie, 2008, Groenewald et al 2014).

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).

Refer to **Appendix A** as well as the recommendations and discussions in the Desktop Surveys and Scoping report for Palaeontological Impacts (Internal Report, 2015) for further discussions on heritage management and legislative frameworks

1.5 Terminology

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

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

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, such as the caves with archaeological deposits identified close to both development sites for this study.

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

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.

1.6 Abbreviations

Table 4: Acronyms

Acronyms	***Description***
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
CCS	Cryptocrystalline silicate
DEA	Department of Environmental Affairs
DoE	Department of Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System

HIA	Heritage Impact Assessment
HV	High Voltage
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
PV	Photovoltaic
ROD	Record of Decision
SPV	Special Purpose Vehicle
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

2 TECHNICAL DESCRIPTION

The proposed development will encompass the construction of the Sendawo common collector substation, power line and associated components / infrastructure, in order to feed electricity generated by the proposed Sendawo solar PV energy facilities (part of a separate ongoing EIA processes) into the Eskom grid. The proposed Sendawo common collector substation and associated power line will have a voltage capacity of up to 400kV. The power line will run from the Sendawo common collector substation to the Mookodi MTS and will have a servitude width of between 31m and 55m. The power line will consist of a series of towers located approximately 250 to 400m apart, depending on the terrain. It is proposed that the steel lattice tower type (518H and 518C), would predominantly be used for the proposed power line in combination with other towers (Figure 1), as required (e.g. guyed 'vee' suspension towers). The exact location of the towers will be determined during the final design stages of the power line. Access roads to the proposed substation and administration, control and warehouse buildings will form part of the associated components / infrastructure. The total area of the assessed substation site is 6.25 hectares, with the proposed power line corridor alternative 2A and 2B lengths being 4.73 km and 5.95 km respectively.

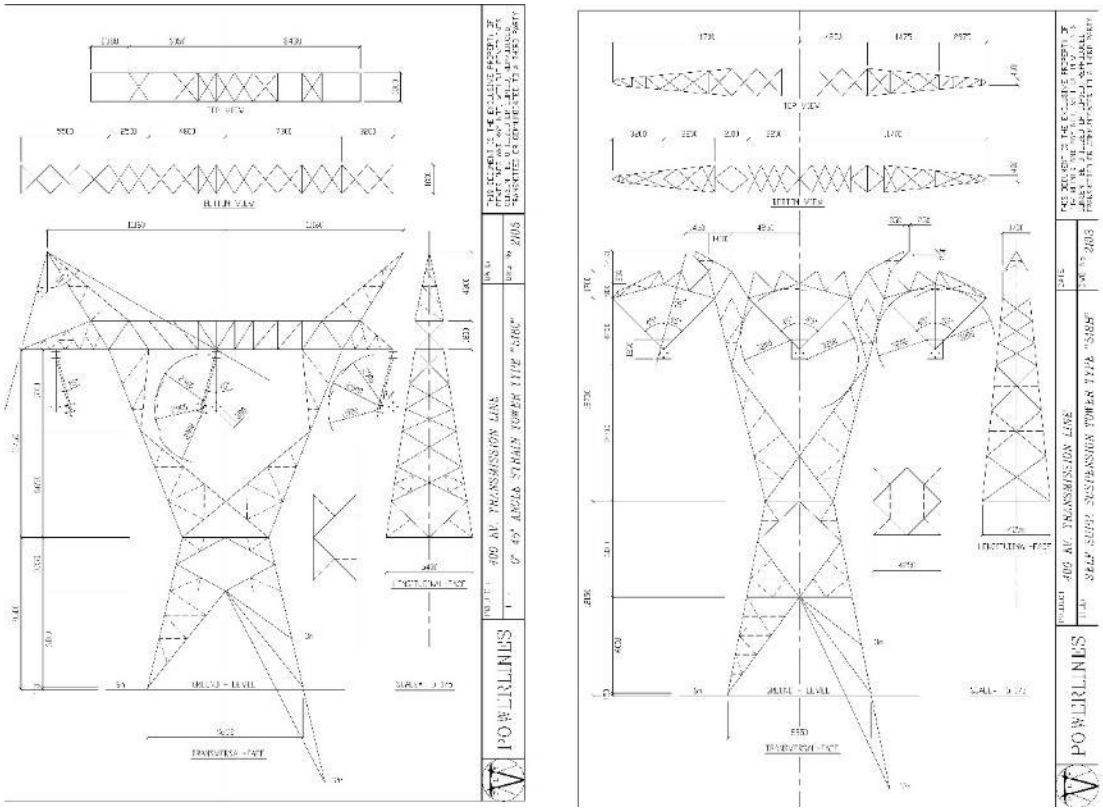

Figure 1**:** Typical Steel Lattice Tower Types

2.1.1 Substation and Power line Project Components

BioTherm is proposing the establishment of the Sendawo common collector substation, power line and associated infrastructure on the development site near Vryburg.

The key technical details and infrastructure required are presented in the table below (Table 5).

Table 5: Sendawo Common Collector Substation and Power Line technical summary

Project Name	**Farm name and area**	**Technical details and infrastructure**
Sendawo Substation and Power Line	▪ Portion 1 of the Farm Frankfort No 672; ▪ Portion 1 of the Farm Rosendal No 673; ▪ Portion 2 of the Farm Rosendal No 673;	▪ **Grid connection** for the three (3) Sendawo solar PV energy facilities will be to the proposed on-site Sendawo common collector substation; ▪ The **voltage capacity** of the proposed on-site Sendawo Substation is anticipated to be up to **400kV**;

	▪ Remainder of the Farm Rosendal No 673; ▪ Portion 2 of the Farm Waterloo No 730; ▪ Portion 3 of the Farm Waterloo No 730; ▪ Portion 4 of the Farm Waterloo No 730; and ▪ Portion 1 of the Farm Edinburgh No 735. Substation Site Area: 6.25 ha Power Line Corridor Alternative 2A length: 4.73 km Power Line Corridor Alternative 2B length: 5.95 km	▪ The on-site Sendawo common collector substation will be a **common substation** connecting the three (3) projects to the Mookodi Main Transmission Substation (MTS); ▪ The proposed on-site Sendawo common collector substation will occupy a **footprint area of approximately 6.25ha**; ▪ The Sendawo common collector substation will be a common substation connecting the three (3) project to the Mookodi MTS; ▪ **A power line(s) associated with the Sendawo common collector substation of up to 400kV** is also proposed and will run from the proposed Sendawo common collector substation to the existing Mookodi MTS; ▪ The proposed power line will have a **servitude width of up to 55m**; ▪ The typical structure to be used would predominantly be the **steel lattice tower type** (518H and 518C) power line in combination with other towers, as required (e.g. guyed 'vee' suspension towers). The steel lattice tower type height will vary with the terrain. ▪ The **power line towers** are expected to be placed approximately 250m to 400m apart, depending on the terrain; ▪ A **laydown area** for the temporary storage of materials during the construction activities; ▪ **Access roads**; and ▪ **Administration, control and warehouse buildings.**

As previously mentioned, the proposed Sendawo common collector substation will be a shared substation connecting the three Sendawo solar PV energy facilities to Eskom's Mookodi MTS Each of the three (3) proposed Sendawo solar PV energy facilities (namely Sendawo 1, Sendawo 2 and Sendawo 3) will require separate Environmental Authorisation, the EIAs for these are being conducted separately.

2.1.2 Buildings

The proposed development will require onsite buildings which will be used in the daily operation of the proposed substation and power line and includes an administration building (office). Potential

locations for the administration building will be determined at a later stage during the EIA process based on any environmental constraints identified and design factors that need to be considered. The buildings will be required to accommodate the following:

- Control room
- High Voltage (HV) switchgear
- Kitchen
- Toilets
- Storage

2.1.3 Other Associated Infrastructure

Other associated infrastructure includes the following:

- Access roads to the substation and power line corridor.

2.2 Alternatives

Two alternative corridors for the power line routes are proposed and are discussed in this Phase 1 PIA report (Figure 2).

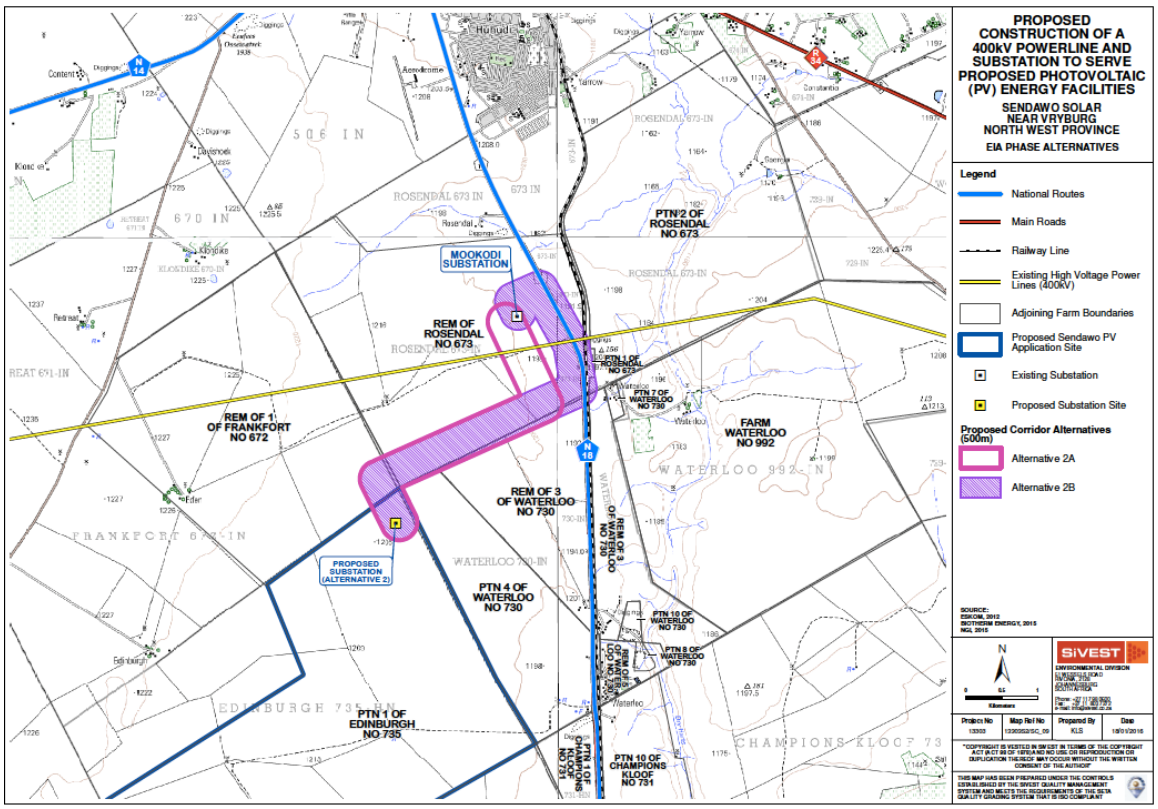

Figure 2: Two alternative routes for power line corridors

3 ASSESSMENT METHODOLOGY

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

3.1 Methodology for Assessing Palaeontological Heritage Site significance

Dr Gideon Groenewald compiled this Palaeontological Heritage Assessment Document as part of the Heritage Impact Assessment (HIA) report for the proposed Sendawo Solar facilities grid connections. 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:

3.1.1 Scoping Phase

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

3.1.2 Impact Assessment Phase

Step II – Physical Survey: On Wednesday 18 February 2016, a Phase 1 PIA Survey was conducted by vehicle and on foot through the proposed project area by two qualified palaeontologists, Dr Gideon Groenewald and David Groenewald. The survey aimed at locating and documenting any palaeontological sensitive information falling within and adjacent to the proposed development footprint (Figure 3).

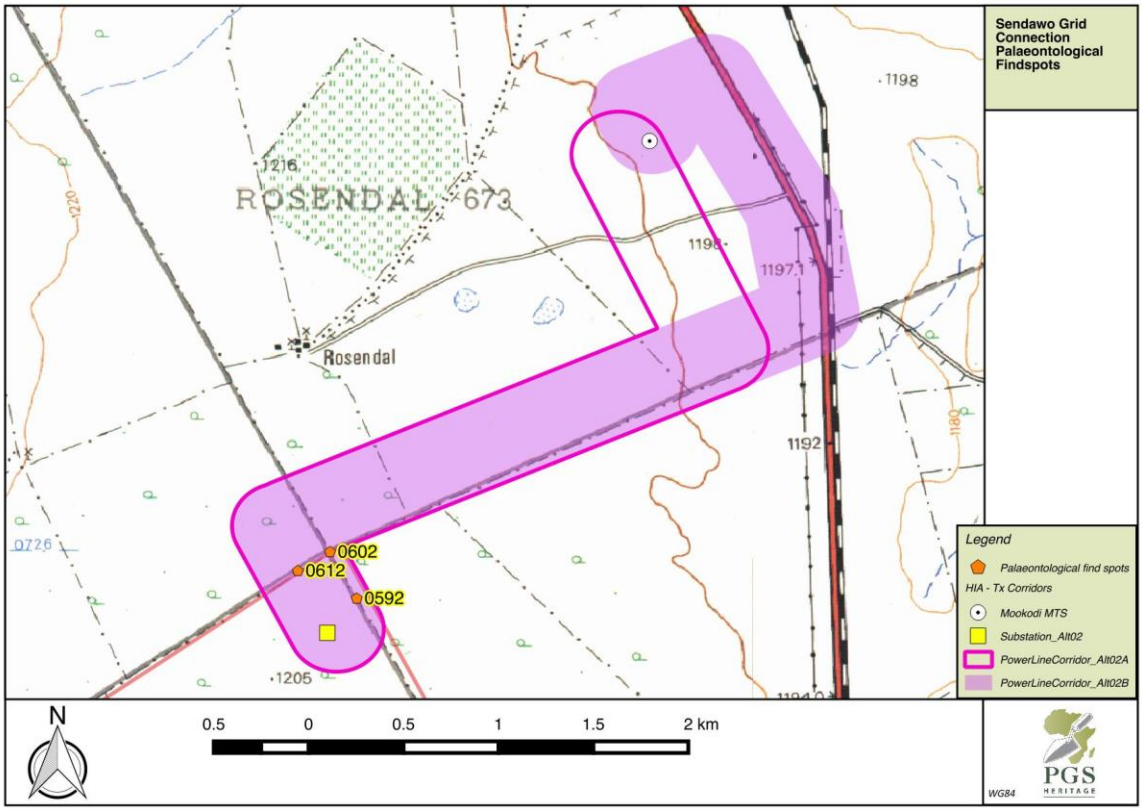

Figure 3: Two routes for powerline corridors. Observation points are indicated as GPS station numbers

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

Appendix B, outlines the Plan of study for the Heritage Impact Assessment process, while **Appendix C** provides the guidelines for the impact assessment evaluation that was used during the EIA phase of the project.

4 BACKGROUND RESEARCH

Historical data and cartographic resources (1:250 000 scale geological map 2624 Christiana), as well as Google Imagery were used as a critical additional tool for locating and identifying palaeontological heritage resources and in determining the historical and cultural context of the study area. Relevant topographic maps and satellite imagery were studied (Scoping Report and Desktop PIA report, Groenewald, 2015).

4.1 Previous Studies

Researching the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that the proposed area for the development of the PV panel layout falls in high and very highly sensitive palaeontological heritage regions due to the very high possibility of finding significant stromatolites structures as well as Quaternary aged cave breccia with possible Homonin fossil remains.

4.2 Findings from the studies

4.2.1 Geology

The following map (Figure 4) is an extract from the palaeontological desktop study completed by Groenewald (2015) for the proposed solar project on the farm Edenburgh 735 and Hartsboom 734, forming a large part of the study area. The map indicates the main geological units as indicated on the map:

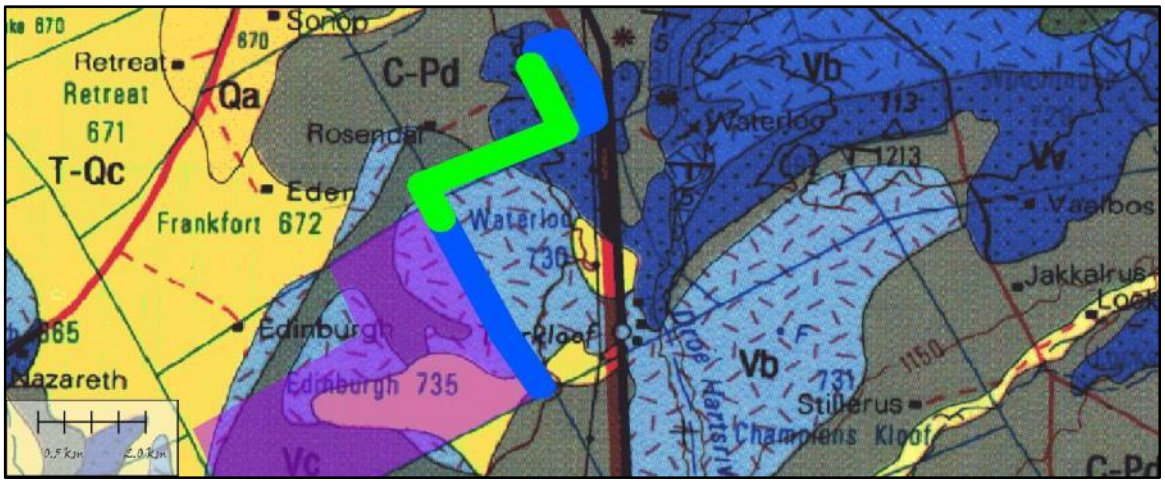

Figure 4: Geology of the study area. For legend see Figure 5 (Coucil for Geoscience, Pretoria)

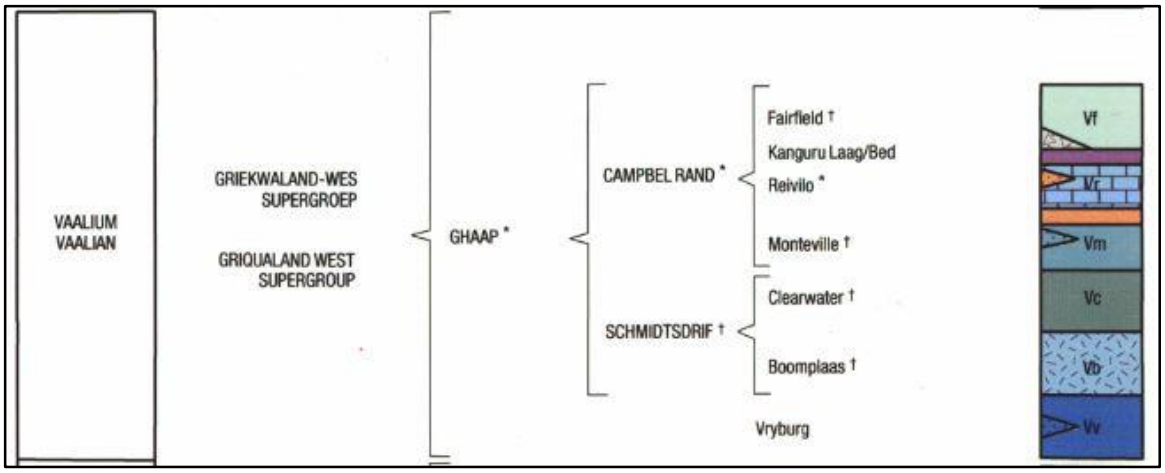

Figure 5: Geological Legend to Figure 4

The study area is underlain by Vaalian aged dolomites and shale of the Schmidtsdrift Subgroup and the Campbel Rand Subgroup, Ghaap Group of the Griqualand West Supergroup and Tertiary to Quaternary aged calcrete and windblown sand (Figure 4).

4.2.2 Griqualand West Supergroup

Ghaap Group.

Vryburg Formation
Vaalian aged quartzite, flagstone, conglomerate, shale and dolomite with interbedded Andesitic lava.

Schmidtsdrift Subgroup

Boomplaas Formation

The Vaalian aged Boomplaas Formation is predominantly a chert-rich dolomite with interbedded banded chert, oolitic chert and shale (Johnson et al, 2009).

Clearwater Formation

The Vaalian aged Clearwater Formation is predominantly a shale and quartzite formation with minor dolomitic layers (Johnson et al, 2009).

Calcrete and Silcrete
Tertiary to Quaternary aged calcrete and silcrete underlies the central part of the study area (yellow on Map).

5 PALAEONTOLOGY OF THE AREA

5.1 Griqualand West Supergroup

5.1.1 Ghaap Group

Vryburg Formation

The Vallian aged Vryburg Formation is predominantly a quartzite and shale formation with minor dolomites and andesitic lava. Micro stromatolites can be associated with the dolomite zones but no fossils were observed during this investigation.

5.1.2 Schmidtsdrift Subgroup

The dolomites of the Scmistdrift subgroup contain a range of shallow marine and lacustrine stromatolites (some very large), oolites, and pisolites in carbonates, filamentous and coccoid organic walled microfossils such as cyanobacteria in siliciclastics and carbonates, as well as cherts.

Dolomite areas are allocated a Very High Palaeontological Sensitivity due to presence of cast topography and possible cave breccias with potential Homonin fossils. Diverse Late Pliocene to Pleistocene (Makapanian, Cornelian, Florisian) mammalian biotas, including several extinct Hominins (spp. of *Australopithecus, Paranthropus, Homo*), micromammals, reptiles (lizards), frogs, birds, land snails, coprolites, stone and bone artefacts, plant remains (e.g. petrified wood, palynomorphs). A number of very important fossiliferous cave sites are for example present in Cradle of Humankind near Klerksdorp (Gauteng & North West)

5.1.3 Boomplaas Formation

The Vaalian aged Boomplaas Formation is a chert-rich dolomite with stromatolite structures and oolitic chert layers. Recording of these structures contributes significantly to our understanding of the palaeo-environments in this part of South Africa.

Groenewald (2015), indicated that the, "*The very high fossiliferous potential of the Boomplaas Formation, warrants an allocation of a Very High palaeontological sensitivity to the areas underlain by the rocks of the this formation. All the areas underlain by Dolomite have a very high potential of containing cave breccias with highly sensitive fossil remains including remains of Homonin fossils*".

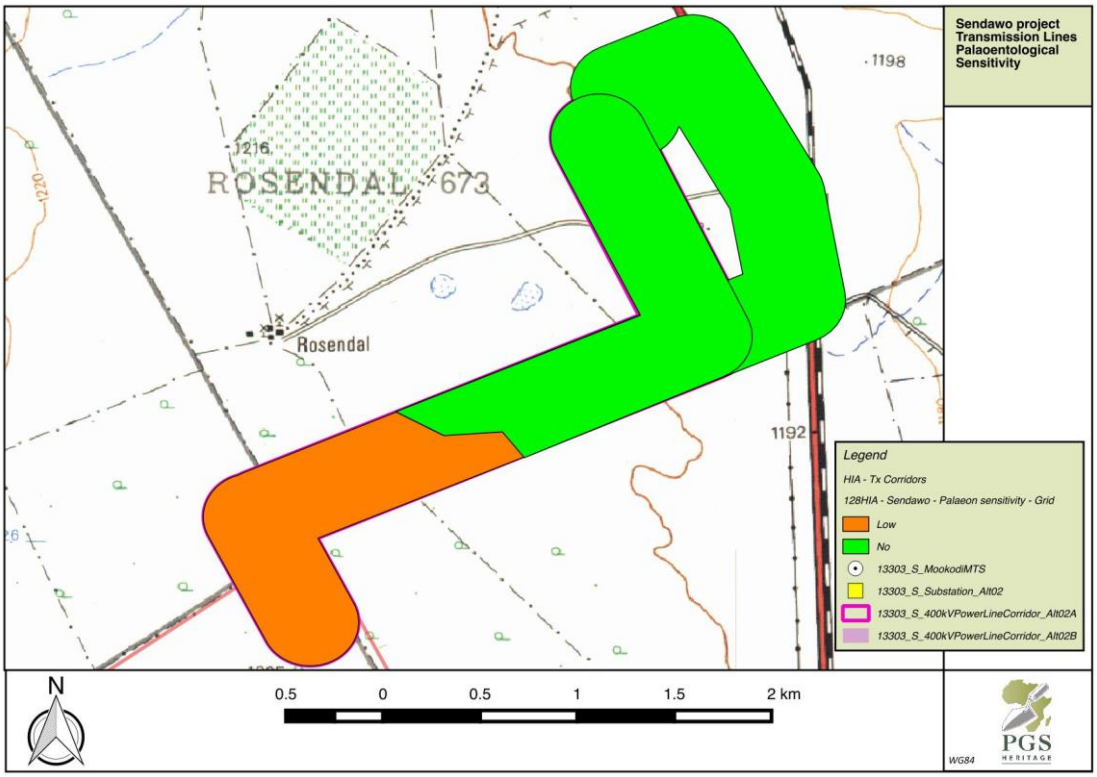

Figure 6: Palaeontological sensitivity (less important stromatolites in dolomite boulders and minor outcrop in orange area, and no fossils observed in green area)

5.1.4 Possible finds

Evaluation of historical data, geological map and satellite images has indicated that large parts of alternative routes 2A and alternative 2B might have fossils associated with the dolomitic terrain (Figure 6).

To be able to compile a heritage management plan to be incorporated into the Environmental Management Plan the following further work will be required for the EIA.

- Palaeontological assessment of the area after completion of the geotechnical investigations to identify possible cave breccias and possible sites of sink hole formations.

6 IMPACT ASSESSMENT

6.1 Field work findings

6.1.1 Methodology

Fieldwork was conducted in the proposed powerline corridor areas of the Sendawo Project on 18 February 2016. The methodology focused of a tracked drive- and walkthrough of the foot print areas of the two proposed power line corridors (Alternative 2A and 2B) from the site to the Mookodi Main Transmission substation. An accredited professional palaeontologist, Dr Gideon Groenewald, assisted by David Groenewald, completed the fieldwork. All the fieldwork was done by vehicle and on foot and consisted of several kilometres of tracked field walking through the proposed development areas (**Figure 7**).

6.1.2 Sites

During the fieldwork it was observed that most of the areas have little outcrop but an area at GPS stations 0482 to 0562 has significant outcrops of dolomite with both stromatolites and possible cave breccia (**Table 4**) (Outside the alignment area).

The fieldwork findings have shown that a small part of the study area is characterised by the presence of significant Stromatolites and that stromatolites are present in almost all the dolomite boulders on site. Some areas have possible remains of cave breccia but no in situ outcrops were recorded.

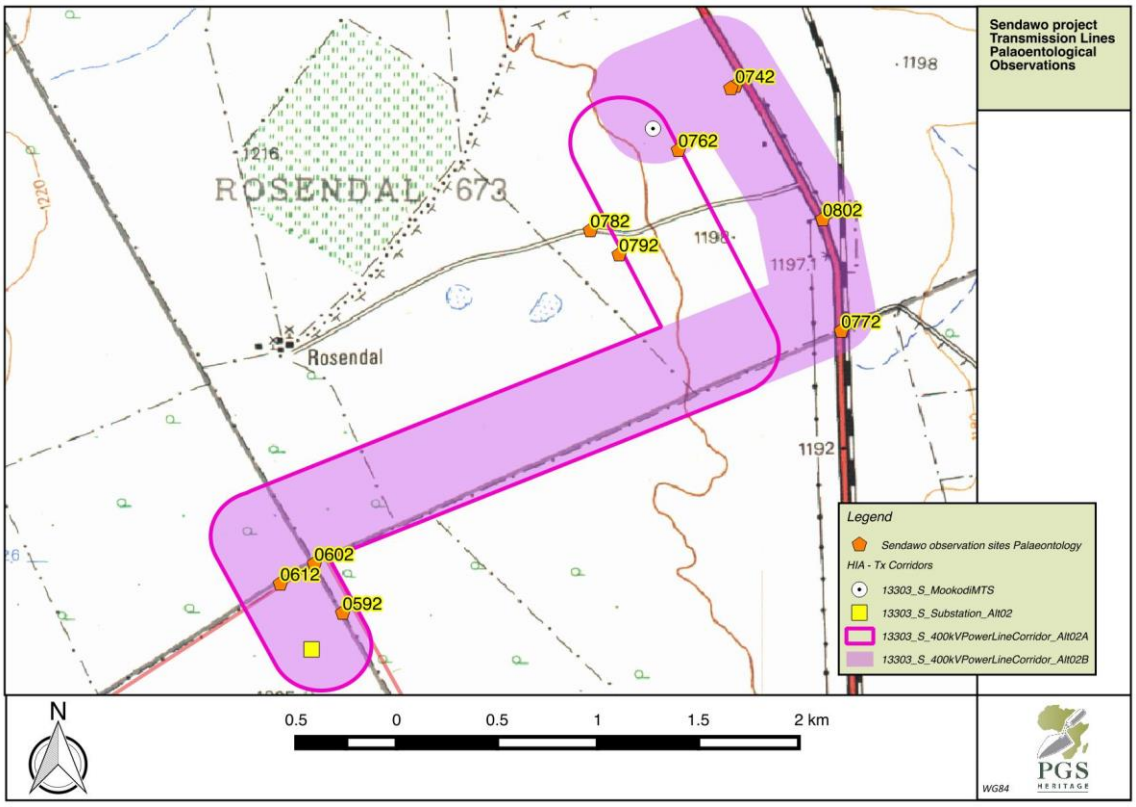

Figure 7: GPS Station points for photographic recording of palaeontological observations as summarised in Table 6

Table 6: Photographic observations during fieldwork session (See Figure 6)

Photo	GPS station no (Figure 7) and coordinates	Description	Picture
1	(0592) -27° 02' 02.7" 24° 43' 43.1"	Deeper red sandy soils in possibly Tertiary Aged river bed. outcrops are mostly shale and quartzite outcrops with minor stromatolitic dolomites	

2	(0602) -27° 01' 53.9" 24° 43' 38.0"	Deep red soils on shale and quartzite with minor dolomites, no fossils observed	
3	(0612) -27° 01' 57.5" 24° 43' 31.9"	Shallow sandy soils on shale and quartzites with minor dolomite. No fossils observed.	
4	(0752) -27° 00' 28.2" 24° 44' 53.1"	Deeper sandy soils, windblown sand on shale and quartzites, minor dolomite and no significant fossils observed	
5	(0762) -27° 00' 28.2" 24° 44' 53.1"	Sandy soil on quartzite and shale, no fossils observed	

6	(0772) -27° 01' 11.9" 24° 45' 13.0"	Shale, quartzite and minor dolomite. No fossils observed	
7	(0782) -27° 00' 53.8" 24° 44' 27.8"	Deep windblown sand on quartzite, shale and minor dolomite. No fossils expected, no fossils observed.	
8	(0792) -27° 00' 53.8" 24° 44' 27.8"	Deep sandy soils on windblown sand covering shale, quartzite and minor dolomite. No fossils observed	
9	(0802) -27° 00' 51.9" 24° 45' 09.7"	Interbedded shale,quartzite, shale and dolomite with thin windblown sand cover. No significant stromatolites or other fossils observed	

10	(0802) -27° 00' 51.9" 24° 45' 09.7"	Deep windblown sand with quarry into interbedded quartzite, shale and lava. Very few fossils expected in outcrops and no fossils observed	

6.2 Assessment

The fieldwork findings have shown that a small part of the study area is characterised by the presence of significant Stromatolites and that stromatolites are present in almost all the dolomite boulders on site. Some areas have possible remains of cave breccia but no in situ outcrops were recorded.

It must be kept in mind that the fieldwork could in no way identify all palaeontological sites within the development footprint and as such the fieldwork has shown that the possibility of encountering possible cave breccias during geotechnical investigation is relatively high.

The following set of table provides an assessment of the impact on palaeontological heritage resources within the development foot print.

Table 7: Rating of Impacts on Palaeontology - Alternative route 2A and 2B

IMPACT TABLE	
Environmental Parameter	*Palaeontological Resources*
Issue/Impact/Environmental Effect/Nature	*The presence of previously unidentified Palaeontological heritage resources and specifically Palaeontological sites as well as the impact on the identified palaeontological sites*
Extent	*Will impact on the footprint area of the development but will have a significant impact on the National Heritage database*
Probability	*The fieldwork has shown that such a predicted impact could occur*
Reversibility	*Due to the nature of palaeontological sites the impact is seen as irreversible, however mitigation could enable the exclusion of a small area to preserve the highly sensitive sites and collection of enough information to preserve the data from such a site*

Irreplaceable loss of resources	*The development could lead to significant losses in unidentified and unmitigated sites. Fossils can never be replaced*	
Duration	*The impact on heritage resources such as palaeontological sites will be permanent unless mitigated*	
Cumulative effect	*As the type of development impact on a large area, and other similar development in the area will also impact on palaeontological sites the cumulative impact is seen as having a major negative impact.*	
Intensity/magnitude	*The impact on palaeontological sites will require mitigation*	
Significance Rating	*The overall significance rating for the impact on heritage resources is seen as low negative pre-mitigation for both alternative. The implementation of the recommended heritage mitigation measures will address the envisaged impacts and reduce the overall rating to a low impact rating or even significant positive rating if Alternative 2 is preferred.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	2	1
Reversibility	4	2
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	-34 (medium negative)	26 (low positive)
Mitigation measures	*Monitoring during construction by palaeontologist if fossils are exposed during excavation of more than 1.5m of soil cover*	

6.3 Cumulative Assessment

A large number of solar projects are proposed and some have been approved and is currently in construction around the study area (Table 8).

The need for the implementation of the recommended mitigation measures is of great importance and must be seen in the context of the large areas to be impacted by the construction activity. By

implementing the mitigation measures the cumulative effect will be reduce from a Very High Negative to a High Positive impact rating.

Table 8: Renewable energy developments proposed within a 20km radius from the proposed Sendawo PV power line corridor sites

Proposed Development	DEA Reference Number	Current Status of EIA	Proponent	Proposed Capacity	Farm Details
Tiger Kloof Solar PV energy facility	14/12/16/3/3/2/535	Scoping and EIA processes underway.	Kabi Solar (Pty) Ltd	75MW	Portions 3 & 4 of the Farm Waterloo 730
Sediba Power Plant 75MW PV Solar Facility and associated infrastructure	14/12/16/3/3/2/390	Environmental authorisation received	Sediba Power Plant (Pty) Ltd	75MW	A portion of the remaining extent of the Farm Rosendal 673
Waterloo Solar Park	14/12/16/3/3/2/308	Environmental authorisation received and preferred bidder status (REIPPP window 4).	DPS79 Solar Energy (Pty) Ltd	75MW	Southern portion of the Farm Waterloo 992
Cronos Energy Renewable Energy Generation Project	14/12/16/3/3/2/750	Environmental authorisation received	Cronos Energy (Pty) Ltd	75MW	Remainder of the Farm Elma No 575
75MW Carocraft PV Solar Park and associated infrastructure	14/12/16/3/3/2/374	Environmental authorisation received 29 June 2013. Amended to 75MW on 4 April 2014.	Carocraft (Pty) Ltd	75MW	Portion 1 and the Remainder of the Farm Weltevrede 681
Expansion of the Carocraft Solar Park	14/12/16/3/3/2/699	Scoping and EIA processes underway.	Carocraft (Pty) Ltd	75MW	Southern side of the Remainder of the Farm Weltevrede 681
Woodhouse Solar 1 PV Facility	TBC	Scoping and EIA processes underway.	Genesis Woodhouse Solar 1 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729
Woodhouse Solar 2 PV Facility	TBC	Scoping and EIA processes underway..	Genesis Woodhouse Solar 2 (Pty) Ltd	100MW	Remaining extent of the Farm Woodhouse 729

6.4 Impact Summary

Table 9 provides a summary of the projected impact rating for this project on heritage resources.

Table 9: Projected Impact ratings for the palaeontological resources on site

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Palaeontological resources	Impact during construction	-34	Very High Negative Impact	26	High Positive

7 COMPARATIVE ASSESSMENT OF ALTERNATIVES

Table 10: Key to Preference of the two alternative routes for the power lines

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 11: Preference comparisons of the two alternative routes for the Sendawo power lines

Alternative	Preference	Reasons
POWER LINES		
Alternative 2A	No preference	Although stromatolites are present they are small and mostly associated with boulders on site
Alternative 2B	No preference	Although stromatolites are present they are small and mostly associated with boulders on site

8 MANAGEMENT GUIDELINE

8.1 Heritage Management Plan for EMP implementation

Table 12: Mitigation measures proposed

No.	Mitigation Measures	Phase	Timeframe	Responsible Party For Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)	Cost
A	Include section on possible heritage finds in induction prior to construction activities take place – Refer to Section 9 of this report	Planning /Pre-Construction	Prior to construction	Applicant ECO Heritage Specialist	ECO (Monthly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)	**R5 000**
B	Implement chance find procedures in case where possible heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)		ECO Monthly Checklist/Report	**Possibly R10 000**
C	Implement walk down of final alignment on power line alignment	Pre-Construction	Pre-Construction	Applicant ECO Heritage Specialist	Once off		Completion and development of mitigation measures	**R30 000**
D	Monitoring of construction activities by palaeontologist if indicated after completion of geotechnical report	Construction	During construction	Applicant ECO Palaeontologist	Palaeontologist (Initial 2-day site visit. Then Fortnightly during construction)		Palaeontologist Monthly Checklist/Report	**Monthly R40-50 000**

9 HERITAGE MANAGEMENT GUIDELINES

9.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-
   (a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
   (b) the construction of a bridge or similar structure exceeding 50m in length;
   (c) any development or other activity which will change the character of a site-
      (i) exceeding 5 000 m^2 in extent; or
      (ii) involving three or more existing erven or subdivisions thereof; or
      (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
      (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
   (d) the re-zoning of a site exceeding 10 000 m^2 in extent; or
   (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA).

   This survey and evaluation must include:
   (a) The identification and mapping of all heritage resources in the area affected;
   (b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;
   (c) An assessment of the impact of the development on such heritage resources;
   (d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
   (e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:
   a. Heritage;
   b. Graves;
   c. Archaeological finds; and
   d. Historical Structures.

   This module must be tailor made to include all possible finds that could be expected in that area of construction.

   Possible finds include:
   a. Open air Stone Age scatters, disturbed during vegetation clearing. This will include stone tools.
   b. **Palaeontological deposits such as stromatolites, bone, and teeth in cave breccia deposits** (This report).
4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.
5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.
6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.
7. After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.
8. If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.
9. In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made.
10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process.

Table 13: Roles and responsibilities of archaeological and heritage management when heritage resources are discovered during operations

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology and palaeontology support team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.	The client	Archaeologist and a competent archaeology and palaeontology support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist and Palaeontologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites and fossils when discovered.	The client	Environmental Consultancy and the Palaentologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological and palaeontological components into the employee induction course).	The client	Environmental Consultancy, the Archaeologist and Palaeontologist where applicable
If required, conservation or relocation of burial grounds and/or graves or fossil sites according to the applicable regulations and legislation.	The client	Archaeologist, Palaeontologist and/or competent authority for relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological and palaeontological sites (when discovered). The client with the specialist needs to agree on the scope and activities to be performed	The client	Environmental Consultancy, the Archaeologist and Palaeontologist
When a specialist/archaeologist or palaeontologist has been appointed for	Client and Archaeologist or Palaeontologist	Archaeologist and Palaeontologist

mitigation work on discovered heritage resources, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.		

9.2 All phases of the project

9.2.1 Palaeontology

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area. It is essential that the information gathered during the Geotechnical investigations for developments be made available to the Heritage Practitioner and Palaeontologist to assess the possibility of exposing bedrock with fossils where excavations will exceed 1.5m or where gravity surveys indicate possible karst topography in dolomitic terrains. It is very strongly recommended that the area where significant stromatolites were recorded during fieldwork be excluded from this development.

It is possible that cultural material, including palaeontological finds, will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches 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 is often changed or added to during the subsequent history of the project. 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 as the destruction of highly significant stromatolites can occur if driving or road building is allowed into the area designated as highly sensitive at GPS station 0562 for example.

During the prospecting phase, it is important to recognise any significant material being unearthed, and to make the correct judgment on which actions should be taken. In the event that possible heritage resources are identified a qualified archaeologist/palaeontologist must be contacted to evaluate the finds and make recommendations on the mitigation required.

In addition, feedback reports can be submitted by the palaeontologist to the client and SAHRA to ensure effective monitoring. This archaeological and palaeontological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological or new palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers

therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have a palaeontologist available to do such work. This provision can be made in an archaeological and palaeontological monitoring programme.

In the case where palaeontological material is identified during construction the following measures must be taken:

- Upon the accidental discovery of archaeological or new palaeontological material, a buffer of at least 20 meters should be implemented.
- If archaeological and new palaeontological material is accidentally discovered during construction, activities must cease in the area and a qualified archaeologist or palaeontologist be contacted to evaluate the find. To remove the material a permit must be applied for from SAHRA under Section 35 of the NHRA.

10 CONCLUSIONS AND RECOMMENDATIONS

Palaeontological Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

The Heritage Scoping Report (Desktop PIA study) has shown that the proposed Sendawo Solar project will have palaeontological heritage resources present on the property. This has been confirmed through archival research and evaluation of aerial photography of the sites. Confirmation of actual presence of significant finds were confirmed during the fieldwork site visit to the development site for this project.

Evaluation of geological maps and satellite imagery has indicated the entire development area that may be sensitive from a Palaeontological perspective.

The fieldwork that covered the Sendawo Solar site as well as the proposed power line corridors covered the entire area with an evaluation field of 20 meters for small finds (10 meters either side of the palaeontologist) and 100 meters for larger finds such as possible sinkholes and cave breccias sites with tree growths (50 meters either side of the palaeontologist).

10.1 Find spots

Local scree material and blocks of dolomite were inspected for fossils and all finds were recorded as photographic records (Table 6). Outcrop of bedrock with significant stromatolites fossils was recorded and sites with potential cave breccia were recorded in areas where burrows of large vertebrates such as Aardvark were obviously present in the sandy deposits. Final identification of

possible sites where significant cave breccia will occur will only be identified after completion of the geotechnical surveys.

Mitigation:

- It is essential that the results of the Geotechnical Surveys be provided to the HIA team and palaeontologist to assess the possible presence of sinkholes and cave breccia sites on all the proposed development areas;
- Field assessment indicated the presence of both significant stromatolite structures and possible cave breccia;
- If excavation of deeper than 1.5m is planned, the palaeontologist must assess the results of the geotechnical information and given the opportunity to comment on the likelihood of significant finds of fossils in all the planned development areas;
- If any excavation or collection of fossils is recommended, such mitigation measures will require a permit from SAHRA before mitigation can be done as well as a final destruction permit on completion of the mitigation work.

Due to the presence of significant stromatolites in a small area and the large number of boulders with stromatolites present on site it is recommended that a palaeontologist be appointed to monitor geotechnical investigations as part of a watching brief. The aim being the identification and mitigation of any newly discovered palaeontological sites, if recorded. The significant finds recorded in Table 5 must lead to exclusion of the specific sites from this development.

10.2 Impact Summary

Table 14 provides a summary of the projected impact rating for this project on heritage resources.

Table 14: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Palaeontological resources	Impact during construction	-34	Very High Negative Impact	26	High Positive

10.3 Comparative Assessment for Sendawo Solar Development Power Line Routes

Table 15: Key to Preference of the two alternative routes for the power lines

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 16: Preference comparisons of the two alternative routes for the Sendawo power lines

Alternative	Preference	Reasons
POWER LINES		
Alternative 2A	No preference	Although stromatolites are present they are small and mostly associated with boulders on site
Alternative 2B	No preference	Although stromatolites are present they are small and mostly associated with boulders on site

11 REFERENCES

GROENEWALD, GH., GROENEWALD SM. AND GROENEWALD DP. 2014. Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West Provinces. Internal Palaeotechnical Reports, SAHRA.

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Appendix A

LEGISLATIVE PRINCIPLES

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the new legislation, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources are integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have interest in the graves: they may be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle will be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the developer's cost. Thus, developers will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:
An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection, to all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix B

Heritage Assessment Methodology

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

The Heritage Impact Assessment (HIA) report compiled by PGS Heritage (PGS) for the proposed Helena 1 Solar projects will assess the heritage resources found on site. This report will contain the applicable maps, tables and figures as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998) and the Minerals and Petroleum Resources Development Act (MPRDA) (28 of 2002). The HIA process consists of three steps:

- Step I – Literature Review: The background information to the field survey leans greatly on the Heritage Scoping Report completed by PGS for this site.

- Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists, 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, as well as the assessment of resources in terms of the heritage impact assessment 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 - <10/50m^2
        - Medium - 10-50/50m^2
        - High - >50/50m^2
- **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 pylon position
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site

Site Significance

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

Table 17: 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)	Grade 4A	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	Grade 4B	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	Grade 4C	Low Significance	Destruction

Appendix C

Impact Assessment Methodology to be utilised during EIA phase

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

DETERMINATION OF SIGNIFICANCE OF IMPACTS

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 3.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Classification of sensitivity ratings

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.

DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.

4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Table 2: Impact Assessment

The table below is to be represented in the Impact Assessment section of the report.

IMPACT TABLE FORMAT		
Environmental Parameter	*A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water*	
Issue/Impact/Environmental Effect/Nature	*A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water*	
Extent	*A brief description of the area over which the impact will be expressed*	
Probability	*A brief description indicating the chances of the impact occurring*	
Reversibility	*A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity*	
Irreplaceable loss of resources	*A brief description of the degree in which irreplaceable resources are likely to be lost*	
Duration	*A brief description of the amount of time the proposed activity is likely to take to its completion*	
Cumulative effect	*A brief description of whether the impact will be exacerbated as a result of the proposed activity*	
Intensity/magnitude	*A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	3
Probability	4	4
Reversibility	4	2
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	4	2
Intensity/magnitude	4	3
Significance rating	-96 (Very High Negative)	57 (High Positive)
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analysing the significance. These measures will be detailed in the EMP.*	

Impact Summary

The impacts will then be summarized and a comparison made between pre and post mitigation phases as shown in Table 20 below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity will be averaged. A comparison will then be made to determine the effectiveness of the proposed mitigation measures. The comparison will identify critical issues related to the environmental parameters.

The table below is to be represented in the Executive Summary of the report.

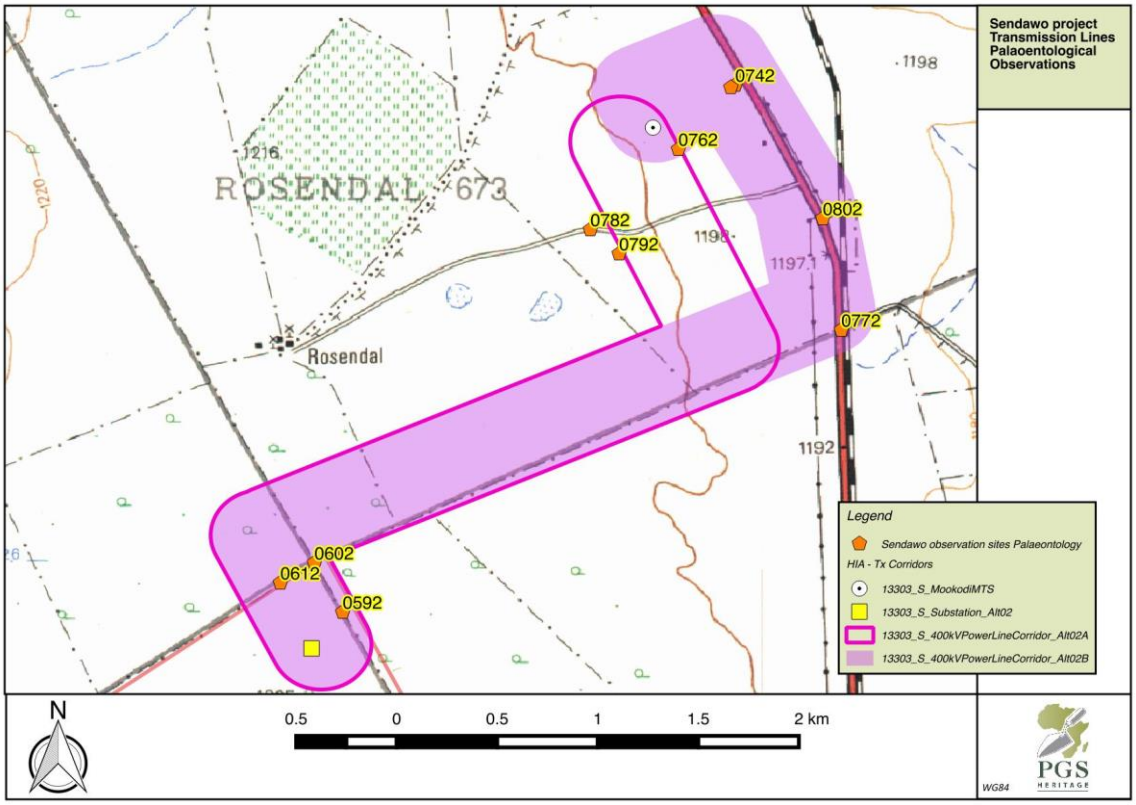
Table 3: Executive Summary

Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Palaeontological Impact	Fossils present	-96		57	
			- 96		**57**
			Very High Negative Impact		High Positive Impact

Finally, the 2010 regulations also specify that alternatives must be compared in terms of impact assessment. Hence all alternatives will need to be comparatively assessed.

Appendix D

Palaeontological Heritage Maps


Sendawo project
Transmission Lines
Palaeontological
Observations
ROSENDAL 673
Rosendal
1216
1198
1197.1
1192
0742
0762
0802
0782
0792
0772
0602
0612
0592
Legend
Sendawo observation sites Palaeontology
HIA - Tx Corridors
13303_S_MookodiMTS
13303_S_Substation_Alt02
13303_S_400kVPowerLineCorridor_Alt02A
13303_S_400kVPowerLineCorridor_Alt02B
N
0.5
0
0.5
1
1.5
2 km
WG84
PGS
HERITAGE