PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED DEVELOPMENT OF THE H2 ENERGY POWER STATION AND ASSOCIATED INFRASTRUCTURE ON PORTIONS 21; 22 AND 23 OF THE FARM HARTEBEESTSPRUIT IN THE THEMBISILE HANI LOCAL MUNICIPALITY, NKANGALA DISTRICT NEAR KWAMHLANGA, MPUMALANGA PROVINCE

Prepared for:
Savannah Environmental (Pty) Ltd
PO Box 148
Sunninghill
Johannesburg
2157

2 October2017

Prepared by

BANZAI ENVIRONMENTAL (PTY) LTD
P.O. BOX 11023
UNIVERSITAS
BLOEMFONTEIN
9323

EXECUTIVE SUMMARY

H2 Clean Energy (Pty) Ltd proposes the development of the 600 MW H2 Energy Power Station and associated infrastructure near KwaMhlanga, in Mpumalanga Province. The development site is located approximately 9km south of KwaMhlanga, and approximately 800m north of the Palesa Coal Mine. According to the National Heritage Resources Act (Act No 25 of 1999, Section 38), a palaeontological impact assessment is required to be undertaken in order to detect the presence of fossil material within the proposed development footprint and to assess the impact of the construction and operation of the project on the palaeontological resources.

The proposed development site of the H2 Energy Power Station (Portions 21; 22 and 23 of Hartebeestspruit 434) is underlain by the metamorphic sediments of the Selons River Formation (Rooiberg Group, 2.06 billion years old) and Ecca Group (Early-Mid Permian, 290-266 million years old, Karoo Supergroup). The metamorphic rocks are unfossiliferous and thus have a zero palaeontological sensitivity. The Ecca Group is not known to contain body fossils of vertebrates, but trace and plant fossils have been described as well as coal beds. According to the SAHRIS PalaeoMap a high palaeontological sensitivity is allocated to this Group.

During a site visit to the proposed development site no fossils were recovered on the development footprint. The development as a whole is a fairly flat lying terrain with thick grassy vegetation cover and some trees. The shortage of fossil-bearing sediments and lack of exposure at the proposed sites indicate that the **impact on palaeontological material is low.**

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO in charge of these developments should be alerted. These discoveries ought to be secured (preferably *in situ*) and the ECO ought to alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional palaeontologist.

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

CONTENTS

1 INTRODUCTION

Savannah Environmental (Pty) Ltd has been appointed as the independent Environmental Consultants by H2 Clean Energy (Pty) Ltd for the undertaking of the Environmental Impact Assessment (EIA) process for the proposed H2 Energy Power Station and associated infrastructure.

The proposed power station will have a generation capacity of up to 600 MW. The H2 Energy Power Station is planned to make use of Supercritical (SC) Circulating Fluidised Bed (CFB) boiler technology, dry cooling methods, and dry ash disposal methods. Coal required to fuel the project will be sourced from the Palesa Coal Mine located approximately 800m south of the project site, and will be transported to site via overland conveyor. Bulk water required for the project will comprise treated municipal grey water, and will be supplied via overland pipeline(s) from the Thembisile Hani Local Municipality's Waste Water Treatment Works to be constructed in KwaMhlanga. Electricity generated by the power station will feed into the grid via a new 275kV overhead power line.

Environmental Authorisation (EA) for the bulk water supply pipeline, and power lines will be obtained under separate applications for Authorisation, and have therefore been excluded from the current scope of EIA. Mention will however be made of these facilities.

Description

The facility is proposed to make use of Supercritical (SC) Circulating Fluidised Bed (CFB) boiler technology and will include the following infrastructure:

- Power generation units – up to 4 power generation units are proposed for the project. These units will consist of boilers, turbines, a generator and associated equipment, and a control room. They will make use of Circulating Fluidised Bed (CFB) boiler technology, and dry cooling methods; and will have a generation capacity of up to 600 MW. Supercritical (SC) boiler technology is envisaged for implementation. SC boiler technology is more efficient than conventional subcritical boiler technology, and will result in reduced emissions and waste streams.
- Overland coal conveyor – an overland conveyor will be constructed between the Palesa Coal Mine and proposed project site, to provide for the supply of raw coal to the project.
- Raw material loading and offloading, storage areas, and handling facilities – designated areas for the loading and offloading, and storage of raw materials such as coal and limestone will be established on site. These storage areas will be equipped with necessary infrastructure such as stackers and reclaimers. The main coal stockpile will be located within the mine property, with a strategic 30-day stockpile located on the site.

- Coal crusher – to allow for the crushing of Run of Mine (RoM) coal to adequate size for use in the combustion process in the boilers.
- Flue Gas Cleaning and main Stack.
- Ash dump – Ash generated by the project will be stored in an above-ground ash dump to be located within the project site. Dry ashing technology will be used. Ash stored in the ash dump will be compacted and rehabilitated using topsoil and vegetation.
- Water infrastructure such as a raw water storage dam, storm water runoff dam, ash dump runoff dam, and wastewater treatment plant– bulk water required to supply the project comprising treated Municipal grey water will be transported to site via overland pipeline(s). Bulk raw water will be treated in the onsite wastewater treatment plant to create boiler feed water for use in the power station, potable water, as well as water to be used in the firefighting pumps and emergency diesel feed water pumps. Rain water runoff from the power station and coal stockpile will be collected in a storm water runoff dam before being treated for use in dust suppression activities. Runoff collected from the ash dump will be stored in an ash dump runoff dam, and will be used for ash conditioning in the ash dump sprays. Wastewater and effluent generated onsite will be collected, reused and recycled such that no offsite disposal will be required. The power station will be designed as a Zero Liquid Effluent Discharge (ZLED) site.
- A substation – for the transformation of electricity generated by the project, and to allow for its integration into Eskom's national electricity grid before being transmitted and distributed to end users.
- Office and maintenance area/s and buildings – to support the onsite personnel and day-to-day functioning, and successful running and maintenance of the project. These include administrative buildings, change houses and bathrooms, security building, medical station, and canteen.
- Access roads – to provide main and secondary access to, and within the proposed project site and its various facilities.

The project is intended to form part of the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme. Ultimately, the power generated from the power station will feed into and supplement the national electricity grid.

The Power Plant Facility design is based on the availability of 3 million tonnes per annum RoM coal from Palesa Coal Mine for the remaining 30 year Life of Mine (LoM). The plant capacity will be up to a maximum of 600 MW electricity production with the project potentially being implemented in phases.

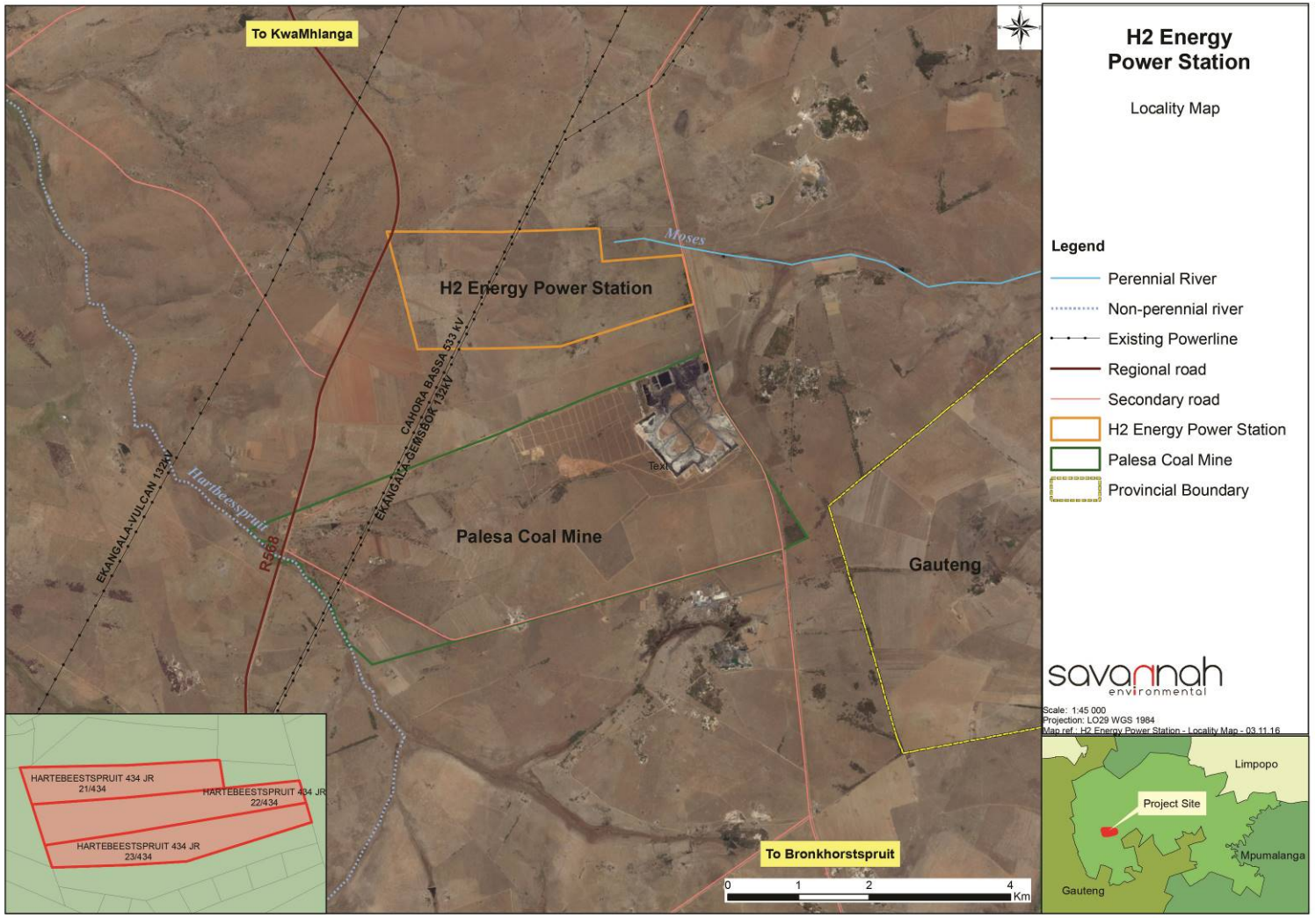

Figure 1: The location of the 600 MW H2 Energy Power Station and associated infrastructure located on Portions 21; 22 and 23 of the Farm Hartebeestspruit No 434 in the Thembisile Hani Local Municipality, Nkangala District near KwaMhlanga, Mpumalanga Province (Map provided by Savannah Environmental)

1.1 LEGISLATION

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

SECTION 25 OF THE NATIONAL HERITAGE RESOURCES ACT 25 OF 1999

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- All archaeological objects, palaeontological material and meteorites are the property of the State.
- Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
- No person may, without a permit issued by the responsible heritage resources authority—
    - Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
    - Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
    - Trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
    - Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
    - Serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order; and/or
    - Carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary.

2 Objective

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports' the aims of the palaeontological impact assessment are:

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

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

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

- the palaeontological importance of the rocks and
- the character and magnitude of the development footprint and quantity of new bedrock excavated.

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

3 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this time the basin developed from an inland sea flooded by a melting ice cap, to a giant lake fed by seasonal meandering (and occasionally braided) rivers. The lake gradually disappeared as it filled with sediment and the basin's rate of subsidence become stable.

The Beaufort Group comprises of largely fluvial sediments which were deposited on the floodplains of these rivers. In time the land became increasingly more arid and was covered with windblown sand just before the end of the basin's cycle. Finally the subcontinent was flooded with basaltic lava to form the capping basalts of the Jurassic aged Drakensberg Group. Throughout the Jurassic, the volcanic Drakensberg were formed and cracks in the earth's crust were filled with lava that cooled to form dolerite dykes. Magma injected horizontally among sediments, cooled down and formed horizontal sills of dolerite.

3.1 Geology

The geology of the study area is on the 1:250 000 geology map 2528 of Pretoria (Council for Geoscience). The H2 Energy Power Station development is underlain by the Selons River Formation (Rooiberg Group, Transvaal Supergroup; approximately 2.6 billion years old) and the Early to Mid-Permian Ecca Group (Karoo Supergroup; approximately 290-266 million years old).

<u>Selons River Formation (Rooiberg Group)</u>
According to SACS (1980) the Rooiberg Group consisted of the Selons River Formation which was divided in the Klipnek Member and the Doornkloof Member. Schweitzer *et al*. (1995) correlated the Doornkloof and Klipnek Members of the Selons River Formation (SACS, 1980) with the Schrikkloof and Kwaggasnek Formations respectively, thus rendering the Selons River Formation and its members redundant. The Kwaggasnek, Schrikkloof, Damwal and Dullstroom Formations are now known as the Rooiberg Group and comprises of volcanic units. Metamorphosed sediments of quartzites, sandstones, mudrocks and cherts are present which is mainly fluvial in origin.

<u>Ecca Group</u>
The Permian aged Ecca Group is characterized by shale, shaly sandstone, grit, sandstone conglomerate, and coal in places near the base and top. The Ecca Group primarily consists of deep water sediments in the south and deltaic sediments with widespread coal beds in the north.

3.2 Palaeontological Heritage

<u>Selons River Formation (Rooiberg Group)</u>

As already mentioned, the Rooiberg Group is approximately 2.6 billion years old and comprises of volcanic units. The Rooiberg Group is not known to be fossiliferous.

Ecca Group

The Ecca Group is not known to contain body fossils of vertebrates, but trace and plant fossils have been described. The Ecca is well-known for the presence of coal beds that formed as result of the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011); *Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia* sp., *Raniganjia* sp., *Asterotheca spp., Liknopetalon enigmata, Glossopteris* more than 20 species, *Hirsutum* 4 spp., *Scutum* 4 spp., *Ottokaria* 3 spp., *Estcourtia* sp., *Arberia* 4 spp., *Lidgetonnia* sp., *Noeggerathiopsis* sp. and *Podocarpidites* sp. According to Bamford (2011) "Little data have been published on these potentially fossiliferous deposits. Around the coal mines there is most likely to be good material and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites, however, in the interests of heritage and science such sites should be well recorded, sampled and the fossils kept in a suitable institution".

This trace fossil assemblage of the non-marine *Mermia* Ichnofacies, is characterised by the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails), mesosaurid reptiles, palaeoniscoid fish, small eocarid crustaceans, trace fossils (track ways. coprolites), insects, organic-walled spores and pollens, petrified wood and rare vascular plant remains.

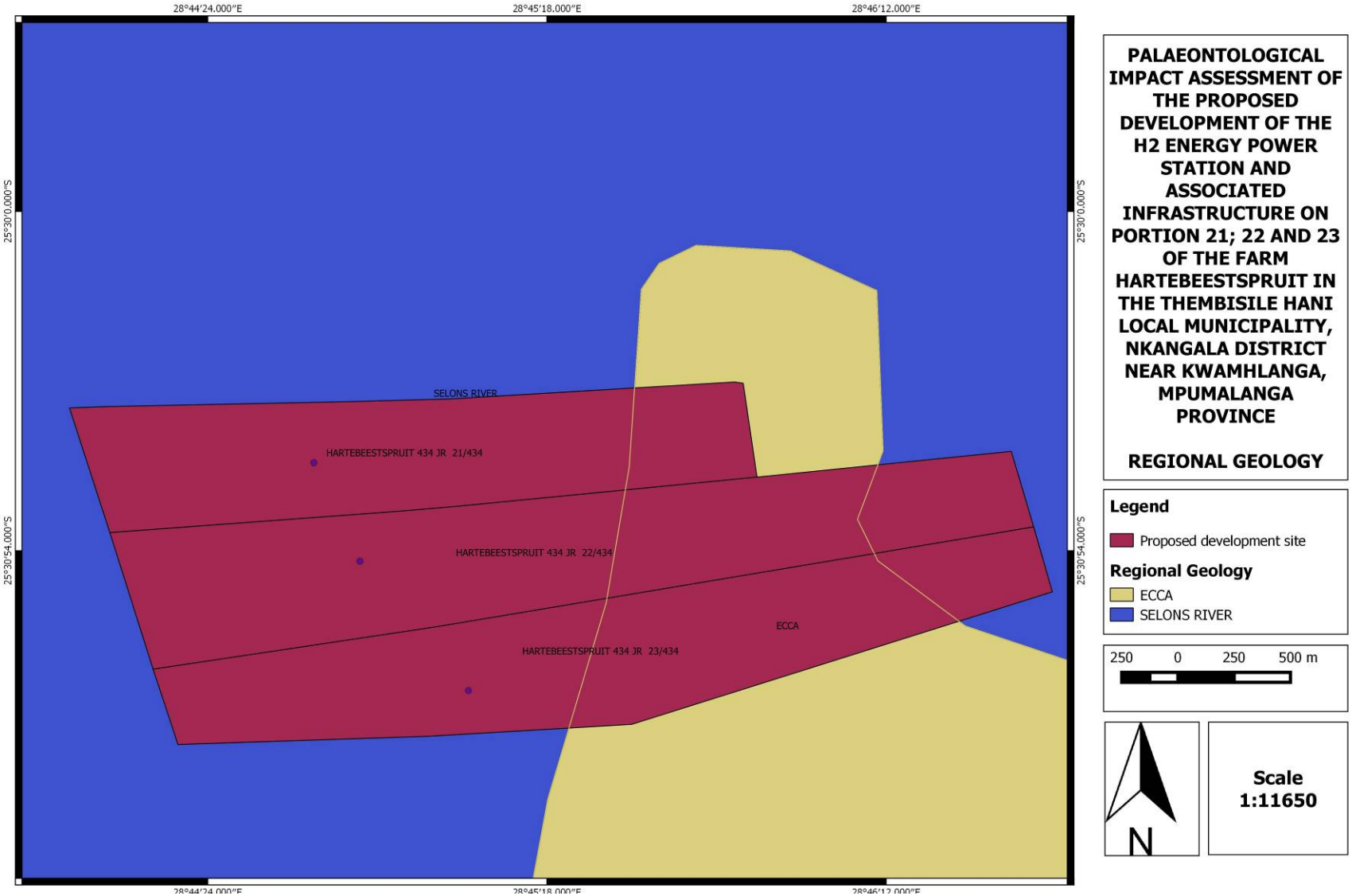

Figure 2: The surface geology of the site proposed for the 600 MW H2 Energy Power Station and associated infrastructure (located on Portions 21; 22 and 23 of the Farm Hartebeestspruit No 434) in the Thembisile Hani Local Municipality, Nkangala District near KwaMhlanga, Mpumalanga Province. The site is completely underlain by the Selons River Formation (Transvaal Group) and Ecca Group.

4 GEOGRAPHICAL LOCATION OF THE SITE

The proposed site is located approximately 9km south of KwaMhlanga, and approximately 800m north of the Palesa Coal Mine in the Thembisile Hani Local Municipality of the Nkangala District in Mpumalanga Province.

5 METHODS

A Palaeontological Scoping study was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2017), topographical and geological maps and other reports from the same area were used to evaluate the proposed area of the development.

5.1 ASSUMPTIONS AND LIMITATIONS

The accurateness and dependability of desktop Palaeontological Impact Assessments as part of heritage impact assessments are normally restricted by the following:

- Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. Much of South Africa has not been studied palaeontologically due to there being so few palaeontologists.
- The accuracy of geological maps where knowledge may be based exclusively on aerial photographs. Sheet explanations for geological maps are unsatisfactory and the focus is not on palaeontological material.

Vast areas of South Africa have not been studied palaeontologically. Fossil data gathered from different areas but in similar Assemblage Zones might provide insight on the probable presence of fossils in an unmapped area. Desktop studies thus generally assume the presence of unexposed fossil heritage within the development areas of similar geological formations. Where extensive exposures of bedrocks or potentially fossiliferous superficial sediments are present in the development area, the dependability of a Palaeontological Impact Assessment may be enhanced through a field-survey.

In order to ensure that an accurate description of the area proposed for the development is considered a field survey was undertaken to ground truth any potential impacts that the facility may have on the palaeontological resources of the site. The field-survey was undertaken on 1st May 2017, as indicated in Section 5 above.

6 FIELD OBSERVATIONS

The following photographs were taken on a site visit to the proposed site for the 600 MW H2 Energy Power Station and associated infrastructure located near KwaMhlanga in Mpumalanga in May 2017.

Figure 3. Lush grass groundcover on the Selons River Formation (Transvaal Group) of the proposed development footprint. The Selons River Formation is unfossiliferous.

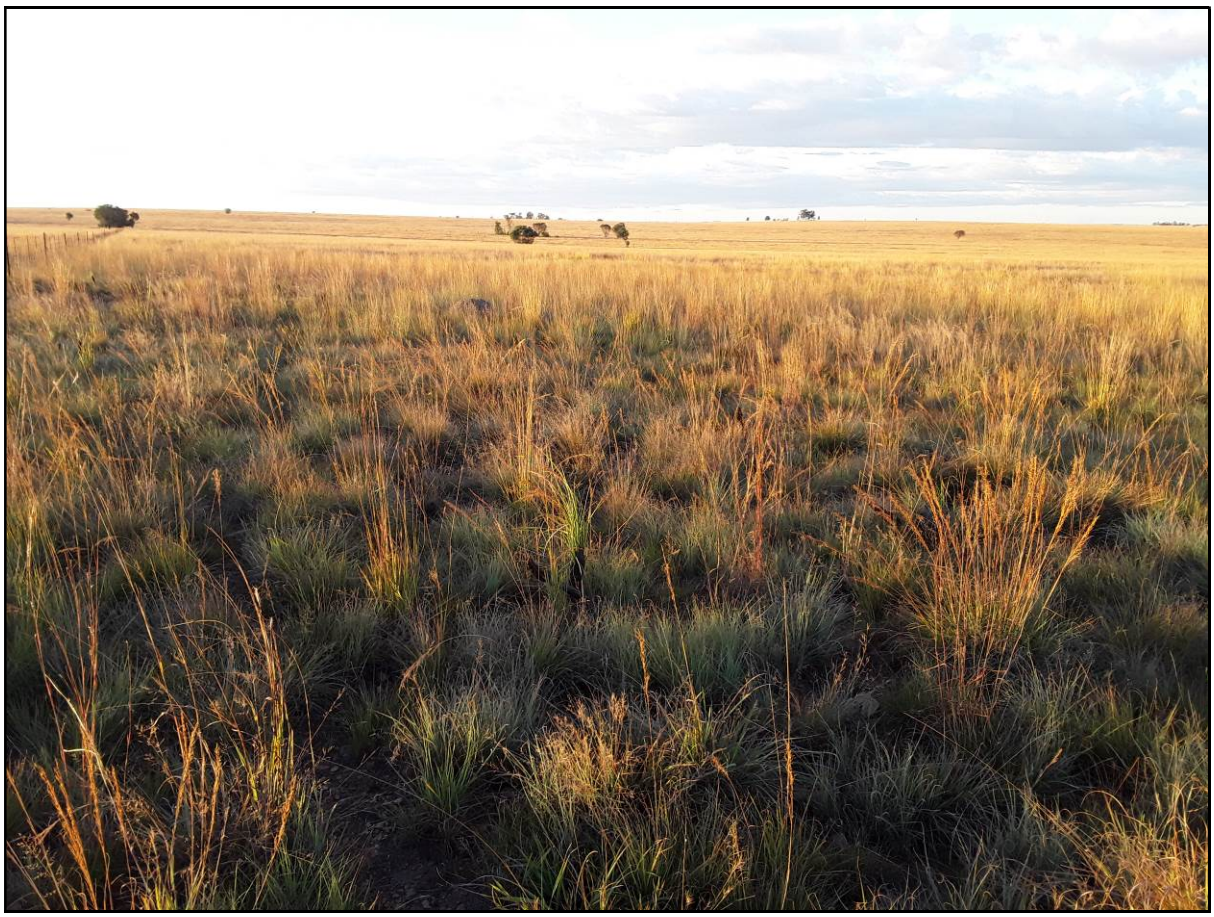

Figure 4. Grass groundcover on the Ecca Group sediments of the proposed development footprint. No fossil exposures were identified.

Figure 5. Small unfossiliferous Selons River Formation outcrop.

Figure 6. Topography of the development footprint.

7 IMPACT ASSESSMENT

An EIA of the impact significance of the proposed 600 MW H2 Energy Power Station and associated infrastructure located on Portions 21; 22 and 23 of the Farm Hartebeestspruit No 434 on local fossil heritage is presented here:

7.1 Nature of the impact

Infrastructure associated with the H2 Energy Power Station includes:
(Information supplied by Savannah)

- Power generation units.
- Overland coal conveyor.
- Raw materials (i.e. coal and limestone) loading and offloading, storage areas, and handling facilities.
- Coal crusher.
- Up to 4 power generation units.
- Flue Gas Cleaning and main stack.
- Ash dump.
- Water infrastructure including a raw water storage dam, wastewater treatment plant and storm water runoff and ash dump runoff dams.
- A substation/switching yard.
- Office and maintenance area/s and buildings.
- Access roads.

The excavations and site clearance will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disrupt, destruct, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific investigation.

7.2 Sensitive areas

The site is underlain by the Selons River Formation (Rooiberg Group) and Ecca Group (Fig. 2). The Selons River Formation is volcanic rocks and is unfossiliferous. The Ecca Group is not known to contain body fossils of vertebrates, but trace and plant fossils have been described from the group. This Group has a high palaeontological sensitivity. Although fossil heritage could be present in the Ecca Group the likelihood of significant fossil heritage in the development area is considered to be of **low significance.** This could be attributed to the scarcity of fossils and the lack of exposure in the development area.

7.3 Geographical extent of impact

The impact on fossil materials and thus palaeontological heritage will be limited to the construction phase when new excavations into fresh potentially fossiliferous bedrock take place. The extent of the area of potential impact is thus restricted to the project site and therefore categorised as **local**.

7.4 Duration of impact

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be **permanent.**

7.5 Potential significance of the impact

Should the project progress without due care to the possibility of fossils being present at the proposed site within the Ecca Group the resultant damage, destruction or inadvertent relocation of any affected fossils will be **permanent and irreversible**. Thus, any fossils occurring within the study area are potentially scientifically and culturally significant and any negative impact on them would be of **high significance**.

7.6 Severity / benefit scale

The development of the proposed H2 Energy Power Station and associated infrastructure is **beneficial** on not only a local level, but regional and national levels as well. The facility will provide a long term benefit to the community in terms of creating jobs and would thus provide an economical boost to the area.

A potential **secondary advantage** of the construction of the project would be that the excavations may uncover fossils that were hidden beneath the surface exposures and, as such, would have remained unknown to science.

7.7 STATUS

Probability of the impact occurring

There is a possibility that fossil heritage will be recorded in the study area. Probable significant impacts on palaeontological heritage during the construction phase are **high**, but the intensity of the impact on fossil heritage is rated as low.

Intensity

The intensity of the impact on fossil heritage is rated as low**.**

8 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSIBLE LOSS

8.1 Mitigation

Should fossil material exist within the area proposed for the development any negative impact upon it could be mitigated by surveying, recording, describing and sampling of well-preserved fossils by a professional palaeontologist. This ought to take place after the initial vegetation removal but *before* the ground is levelled for construction.

Excavation of fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution. In the event that an excavation is impossible the fossil or fossil locality could be protected and the site of any planned construction and infrastructure moved.

8.2 Degree to which the impact can be mitigated

The Ecca Group is not known to contain body fossils of vertebrates, but trace and plant fossils have been described. This Group has a high palaeontological sensitivity but chances that fossils will be found is low. Recommended mitigation of the inevitable damage and destruction of fossil heritage within the proposed site would involve the surveying, recording, description and collecting of fossils within the development area by a professional palaeontologist. This must take place after the initial vegetation clearance has taken place but *before* the ground is levelled for construction. However, the significance of the impact following the mitigation will remain low.

8.3 Degree of irreversible loss

Impacts on fossil heritage are generally irreversible. Well-documented records and further palaeontological studies of any fossils exposed during construction would represent a positive impact from a scientific perspective. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate mitigation procedures. If mitigation is properly undertaken the benefit scale for the project will lie within the beneficial category.

8.4 Degree to which the impact may cause irreplaceable loss of resources

Stratigraphic and geographical distribution of Ecca Group fossils is documented in the literature. It is thus **possible** that exceptional fossil material is present on the development area. By taking a precautionary approach, an insignificant loss of fossil resources is expected.

8.5 Cumulative impacts

The cumulative effect of the development of the H2 Energy Power Station within the proposed location is considered to be low.

9 FINDINGS AND RECOMMENDATIONS

The proposed development site of the H2 Energy Power Station and associated infrastructure (Portions 21; 22 and 23 of Hartebeestspruit 434) is underlain by the metamorphic sediments of the Selons River Formation (Rooiberg Group, 2.06 billion years old,) and Ecca Group (Early-Mid Permian, 290-266 million years old, Beaufort Group, Karoo Supergroup). The metamorphic rocks are unfossiliferous and thus have an insignificant to zero palaeontological sensitivity. The Ecca Group is not known to contain body fossils of vertebrates, but trace and plant fossils have been described. The Ecca is also well-known for the occurrence of coal beds. This Group has a high palaeontological sensitivity.

During a field survey of the proposed development no fossil exposures were recovered on the development footprint. The development as a whole is a fairly flat lying terrain with thick grassy vegetation cover and some trees. The scarcity of fossil-bearing sediments and lack of exposure at the proposed sites indicate that the **impact on palaeontological material is low.** Regardless of the sparse and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific importance as many vertebrate fossil taxa are known from a single fossil.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO in charge of these developments should be alerted. These discoveries ought to be secured (preferably *in situ*) and the ECO ought to alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional palaeontologist.

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

.

10 ASSESSMENT OF IMPACTS

10.1 ASSESSMENT METHODOLOGY

Direct, indirect and cumulative impacts of the impacts identified above were assessed according to the following standard methodology:

- 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 very short duration (0 - 1 years) – assigned a score of 1;
    - The lifetime of the impact will be of 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 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 of 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 syntheses of the characteristics described above and can be assessed as low, medium or high; and
- The **status**, which is described as 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) x 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); and
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

11 IMPACT TABLE

Nature: The excavations and site clearance will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb, damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific research.

	Without mitigation	With mitigation
Extent	Low (1)	Low (1)
Duration	Long term/permanent (5)	Long term/permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (16)**	**Low (16)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Reversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	No
Mitigation: Not necessary There is a possibility that trace fossils, mesosaurid reptiles, palaeoniscoid fish, palynomorphs and petrified wood will be recorded in the proposed development site but the likelihood of significant fossil heritage is considered to be low.		
Residual Risk: Not applicable.		

12 ASSESSMENT OF CUMULATIVE IMPACTS

Nature: Cumulative impacts on fossil remains preserved at or beneath the ground surface.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Local (1)	Low (1)
Duration	Long-term (5)	Long-term (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (16)**	**Low (16)**
Status (positive/negative)	Positive The development of the proposed H2 Energy Power Station and associated	Positive

	infrastructure is **beneficial** on not only a local level, but regional and national levels as well. The facility will provide a long term benefit to the community in terms of creating jobs and would thus provide an economical boost to the area. A potential **secondary advantage** of the construction of the project would be that the excavations may uncover fossils that were hidden beneath the surface exposures and, as such, would have remained unknown to science.	
Reversibility	Low	Low
Loss of resources?	No	No
Can impacts be mitigated?	Yes	Unknown
Confidence in findings: High.		
Mitigation: Not necessary The proposed development site is underlain by the metamorphic sediments of the Selons River Formation (Rooiberg Group, 2.06 billion years old) and Ecca Group (Early-Mid Permian, 290-266 million years old, Karoo Supergroup). The metamorphic rocks are unfossiliferous and thus have a zero palaeontological sensitivity. The Ecca Group is not known to contain body fossils of vertebrates, but trace and plant fossils have been described as well as coal beds. The development as a whole is a fairly flat lying terrain with thick grassy vegetation cover and some trees. The scarcity of fossil-bearing sediments and lack of exposure at the proposed sites indicate that the impact on palaeontological material is low.		

13 RECOMMENDATIONS CONCERNING FOSSIL HERITAGE MANAGEMENT DURING THE CONSTRUCTION PHASE

OBJECTIVE: Prevent the loss of Palaeontological Heritage:	
Project component/s	Damaging impacts on palaeontological heritage occur during the **construction** phase which will modify the existing topography. The facility is proposed to make use of Supercritical (SC) Circulating Fluidised Bed (CFB) boiler technology and will include the following infrastructure: • Power generation units. • Overland coal conveyor • Raw material loading and offloading, storage areas, and handling facilities. • Coal crusher • Flue Gas Cleaning and main Stack. • Ash dump. • Water infrastructure. • A substation. • Office and maintenance area/s and. • Access roads.
Potential Impact	The excavations will modify the current topography and may disrupt and destruct or permanently seal-in fossils at or below the ground surface that are then no longer accessible for scientific study
Activity/risk source	Activities associated with the construction of the development
Mitigation: Target/Objective	Protection of identified fossils uncovered during the construction phase

Mitigation: Action/control	Responsibility	Timeframe
Should fossil material exist within the development footprint any negative impact upon it could be mitigated by surveying, recording, describing and sampling of well-preserved fossils by a professional palaeontologist. This should take place after initial vegetation clearance has taken place. Excavation of fossil heritage will require a permit from SAHRA and the material must be housed in a permitted	Environmental Officer Specialist	Construction phase

Mitigation: Action/control	Responsibility	Timeframe
institution. In the event that an excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction and infrastructure moved.		

Performance Indicator	No impacts on valuable fossil resources
Monitoring	None

14 REFERENCES

ALMOND, J., PETHER, J, and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences. Schweitzer *et al*. (1995) pp p288

MCCARTHY, T & RUBIDGE, B. 2005. *The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey.* Struik. Pp 333

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa. 305 pp. The Geological Society of South Africa, Johannesburg.

SCHWEITZER, J.K., HATTON, C.J., and DE WAAL, S.A. (1995). Regional lithochemical stratigraphy of the Rooiberg Group, upper Transvaal Supergroup: a proposed new subdivision. *S. Afr. Geol*., 98:245-255.

TANKARD, A.J., JACKSON, M.P.A., ERIKSSON, K.A., HOBDAY, D.K., HUNTER, D.R. & MINTER, W.E.L. 1982. Crustal evolution of southern Africa – 3.8 billion years of earth history, xv + 523pp. Springer Verlag, New York.

VAN DER WALT, M., DAY, M., RUBIDGE, B. S., COOPER, A. K. & NETTERBERG, I., 2010. Utilising GIS technology to create a biozone map for the Beaufort Group (Karoo Supergroup) of South Africa. *Palaeontologia Africana,* **45:** 1-5.

VISSER, D.J.L. 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy. Council for Geoscience.

15 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty three years. She has been conducting Palaeontological Impact Assessments since 2014. She has been a Palaeontological Society of Southern Africa member since 2006.

16 DECLARATION OF INDEPENDENCE

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;

- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE:  _____