Phase 1 Palaeontological Assessment of the proposed Tshepo solar power plant (SPP) facility on the Remaining Extent of the farm London 275, near Hotazel, Northern Cape Province.

Report prepared for Environamics by Dr. L. Rossouw, PO Box 38806 Langenhovenpark 9330.

Summary

The assessment indicates that the proposed development footprint, is underlain by well-developed Kalahari Group surface limestones (*Tl*), and wind-blown sands of low palaeontological sensitivity. The paleontologically and archaeologically significant karst features (dolines) within the Kalahari Group sequence are generally highly visible and easy to avoid. Potential impact on palaeontological heritage resources within both the preferred and alternative footprint areas at London 275, as well as along the associated transmission line areas, is on the whole considered to be low to very low. As far as the palaeontological heritage is concerned, the proposed Tshepo SPP and associated transmission line development may proceed with no further palaeontological assessments required.

Introduction

The report provides a field assessment of potential palaeontological impact with regard to the proposed development of the Tshepo solar power plant (SPP) facility on the Remaining Extent of the farm London 275, near Hotazel, Northern Cape Province (and marked on 1:50 000 scale topographic maps 2723AA Tsineng and 2723AC Riries) (**Fig. 1**). The preferred site will cover an area of about 290 ha (general coordinates 27°13'43.67"S 23° 3'32.44"E) and an alternative option covering 250 ha (**Fig. 2**).

The assessment is required as a prerequisite for new development in terms of the National Heritage Resources Act 25 of 1999. The Act identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. In this regard, categories of development relevant to the proposed development are listed in

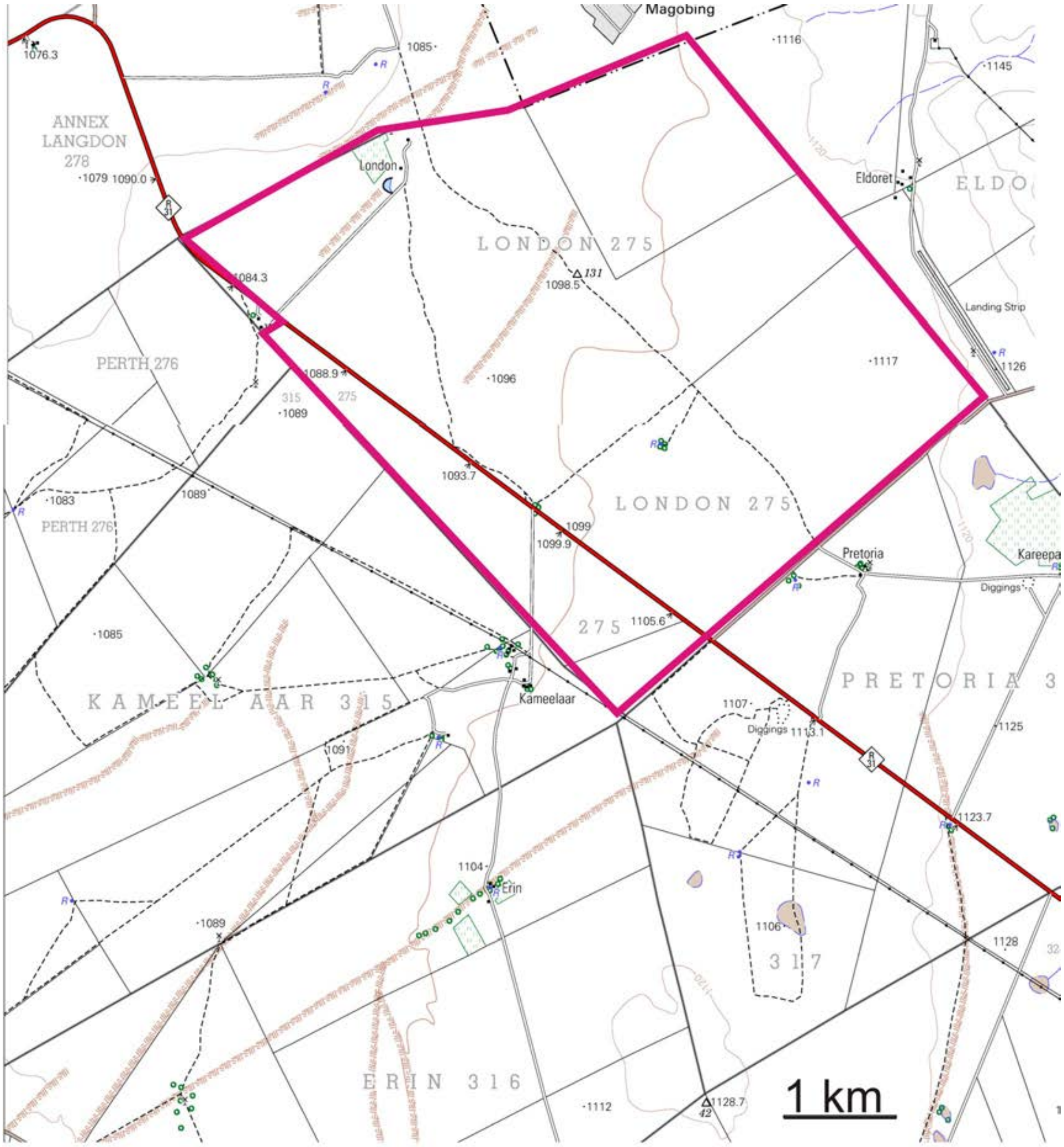

Figure 1. Map of the Remaining Extent of the farm London 275 (portion of 1:50 000 scale topographic maps 2723AA Tsineng and 2723AC Riries).

Section 34 (1), Section 35 (4), Section 36 (3) and Section 38 (1) of the Act, which also include the protection of geological and paleontological sites as well as palaeontological objects and material, meteorites and rare geological specimens. According to the SAHRIS Palaeo Sensitivity Map of South Africa (2016), the proposed development footprint is located within an area considered to be of potentially high palaeontological sensitivity and for that reason requires a phase 1 palaeontological impact assessment.

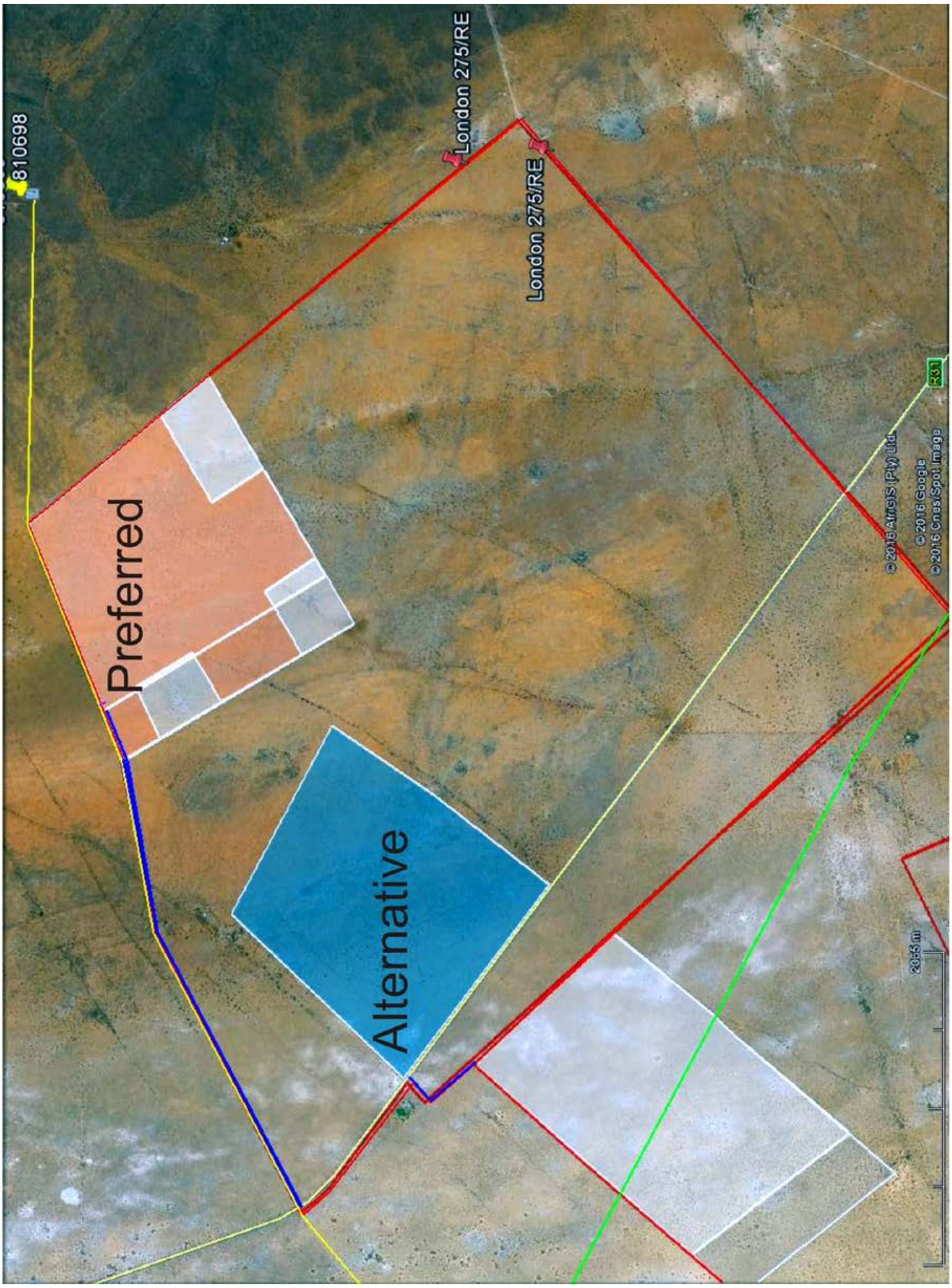

Figure 2. Aerial view of the proposed Tshepo SPP development footprint.

Methodology

The assessment was carried out with the aim to assess the potential impact on palaeontological heritage resources that may result from the proposed development. The palaeontological significance of the affected areas were evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. This was followed by a field assessment by means of a pedestrian survey within the proposed footprint areas. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. A photographic record of the field assessment is listed in **Appendix 1**. The site visit was conducted on the 27th and 28th of February 2016.

Background

Assumptions and Limitations

For the sake of prudence, it is assumed, that fossil remains are always uniformly distributed in fossil-bearing rock units, although in reality their distribution may vary significantly. It is therefore possible that localized fossil exposures could be overlooked during the field assessment.

Geology

The study area is situated within a karstic landscape covered by Kalahari Group surface limestones (*Tl*), calcretes and wind-blown sands (1: 250 000 scale geological map 2722 Kuruman) (**Fig. 3**) with polymict gravels and scree deposits found near streams

Palaeontology

Surface limestones in the region are not considered to be highly sensitive in terms of palaeontological heritage, but the limestone-rich environment can lead to the development of paleontologically and archaeologically significant karst features (dolines) within the Kalahari Group sequence (Beaumont *et al.,* 1984). These features are generally highly visible and easy to avoid. For example, the Precambrian dolomites at the eastern edge of the Ghaap Plateau have been incised at various points by drainage lines that created gorges in which travertine deposits have formed. As a result, the tufas at Norlim (Buxton) near Taung contain highly recognisable solution caves which are fossiliferous, including the one within the Thabaseek Tufa that produced the type specimen of *Australopithecus australis* (Dart 1925; Partridge and Maud 2000). Situated about 600m north-west of the *A. australis* type site, another solution cavity called Equus Cave yielded the Quaternary fossil remains of more than 40 mammalian species, including the extinct taxa *Equus*

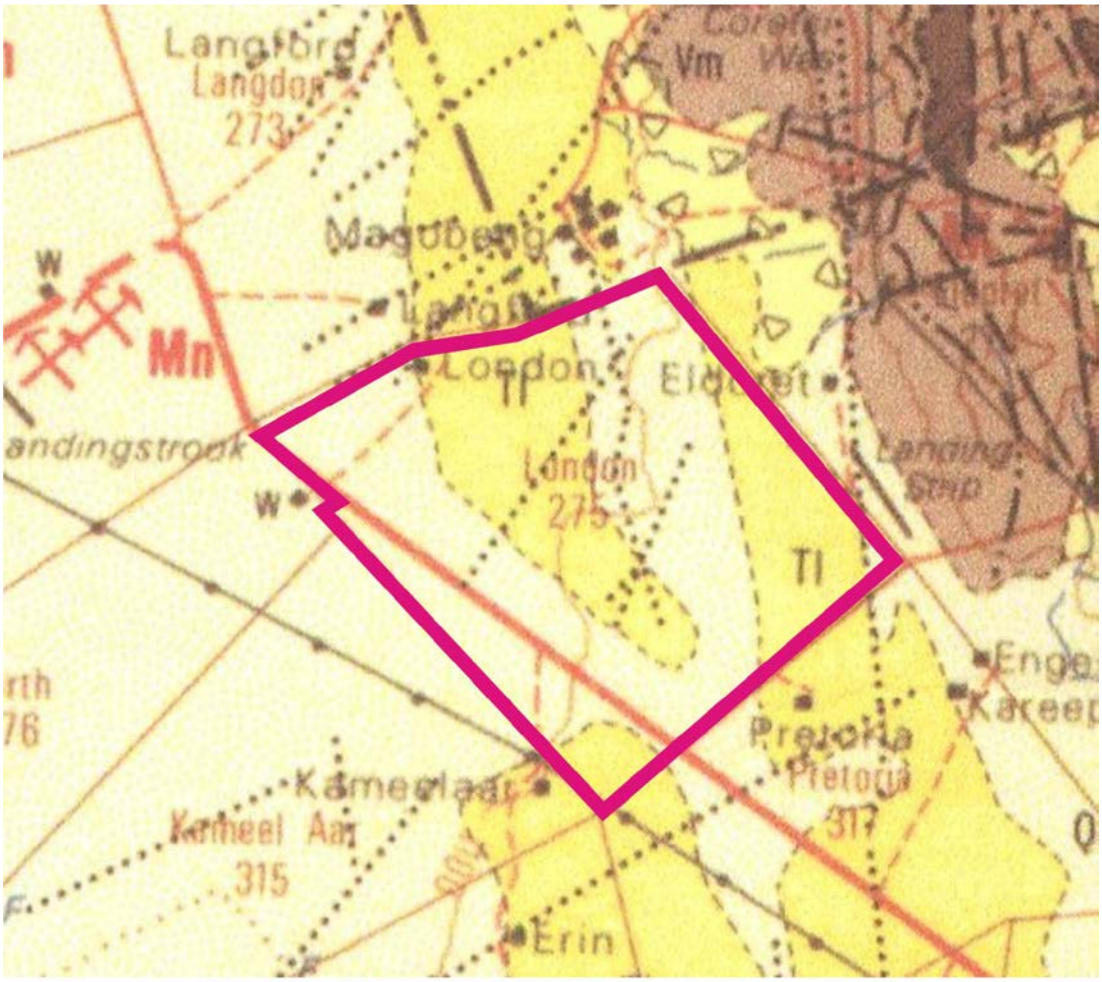

Figure 3. Geological map of the study area (portion of 1:250 000 scale geological map (2722 Kuruman).

capensis, *Antidorcas bondi* and *Megalotragus priscus*. The geologically recent aeolian sand overburden in the region is generally not considered to be fossiliferous, but Quaternary-age surface deposits can be highly fossiliferous in places, especially those that are directly related to fluvial environments along major river courses (Brink *et al*. 1995, Cooke 1955; Churchill *et al.* 2000; Rossouw 2006). Microfossils (diatoms, pollen, phytoliths) and invertebrate remains (e.g. land snails, freshwater bivalves and gastropods) could sometimes be associated with local watercourses and pan dune sediments (Almond and Pether 2008).

Field Assessment

Several deflation areas (pans) were noted but the field assessment found no above-ground evidence of palaeontologically significant dolines or palaeontological exposures within the preferred footprint area at London 275.

Impact Statement and Recommendations

Assessment of impacts, based on the assessment methodology provided by Environamics (see **Appendix 2),** is summarized in **Table 1.** The assessment indicates that the proposed development footprint, is underlain by well-developed Kalahari Group surface limestones (*Tl*), and wind-blown sands of low palaeontological sensitivity. Potential impact on palaeontological heritage resources within both the preferred and alternative footprint areas at London 275, as well as along the associated transmission line areas, is on the whole considered to be low to very low.

Table 1. Paleontological Impact Rating for the Tshepo SPP (see Appendix 2).

PHASE	**Nature**	**Geographical Extent**	**Probability**	**Duration**	**Intensity/Magnitude**	**Reversibility**	**Irreplaceable loss**	**Cumulative Effect**	**Significance Rating**	**Significance**
Planning	Planning for construction of SPP and associated transmission line	Site	Unlikely	Short term	Low	Completely reversible	No loss	Low	7	Negative low impact
Construction	Construction of SPP and associated transmission line	Site	Unlikely	Permanent	Low	Irreversable	Marginal loss	Low	14	Negative low impact
Operation	Overall function of the SPP	Site	Unlikely	Permanent	Low	Irreversable	Marginal loss	Low	14	Negative low impact
Decommissioning	Closing of SPP facility	Site	Unlikely	Permanent	Low	Irreversable	Marginal loss	Low	14	Negative low impact

There are no areas within the preferred as well as the alternative site footprints that need to be avoided and no mitigation measures or further monitoring are required. Potential for cumulative impacts of this project on paleontological resources is considered to be low locally and regionally.

If, in the unlikely event that localized fossil material is discovered within the sandy overburden during the construction phase of the project, it is recommended that a professional palaeontologist be called to assess the importance and rescue the fossils if necessary.

As far as the palaeontological heritage is concerned, the proposed Tshepo SPP and associated transmission line development may proceed with no further palaeontological assessments required.

References

Almond, J.E. & Pether, J. 2008. *Palaeontological heritage of the Northern Cap*e. Interim SAHRA technical report, 124 pp. Natura Viva cc, Cape Town.

Beaumont, P.B., Van Zinderen Bakker, E.M., Vogel, J.C., 1984. Environmental changes since 32,000 BP at Kathu Pan, Northern Cape. In: Vogel, J.C. (Ed.), *Late Cenozoic Palaeoclimates of the Southern Hemisphere*. Balkema, Rotterdam, pp. 329–338.

Brink, J.S., de Bruiyn, H., Rademeyer, L.B. and van der Westhuizen, W.A. 1995. A new *Megalotragus priscus* (Alcelaphini, Bovidae) from the central Karoo, South Africa. *Palaeontologia africana* 32: 17-22

Butzer, K. W. 1984. *Archaeology and Quaternary environment in the interior of southern Africa* **In**: R.G. Klein (ed.) *Southern African prehistory and palaeoenvironments.* Rotterdam. Balkema pp 1-64.

Churchill, S.E., Brink, J.S., Berger, L.R. Hutchison, R.A., Rossouw L., *et. al*. 2000. Erfkroon: a new Florisian fossil locality from fluvial contexts in the western Free State, South Africa. *South African Journal of Science* 96: 161 – 163.

Cooke, H.B.S. 1955 Some fossils in the South African Museum Collection. Annals of the South African Museum 42: 161 – 169.

Dart, 1925 Australopithecus africanus: the man-ape of South Africa. *Nature* 115, 193 – 199.

Partridge, T.C. & Maud, R.R. 2000. *The Cenozoic of Southern Africa*. Oxford Monographs on Geology and Geophysics No. 40.

Rossouw, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust farm, central Free State, South Africa. *Navorsinge van die Nasionale Museum* 22(6): 145-162.

Appendix 1: Photographic record of field assessment

Surface limestones capped by reddish-brown aeolian sand at London 275. Scale 1 = 10 cm.

Appendix 2: Environmental Assessment Methodology

The environmental assessment aims to identify the various possible environmental impacts that could results from the proposed activity. Different impacts need to be evaluated in terms of its significance and in doing so highlight the most critical issues to be addressed.

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 the Table below.

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 impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- 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 should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact the following criteria is used:

Table 1: The rating system

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 experienced.		
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).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes

		in a span shorter than the construction phase (0 – 1 years), or the impact 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 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 – 30 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 indefinite.
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. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact 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.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative 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
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. 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.