APPENDIX D3 HERITAGE

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APPENDIX D3A ARCHAEOLOGICAL

ARCHAEOLOGICAL IMPACT ASSESSMENT THE PROPOSED DISSELFONTEIN KEREN ENERGY SOLAR PLANT NEAR HOPETOWN NORTHERN CAPE PROVINCE

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Executive summary

The Agency for Cultural Resource Management was appointed to conduct an Archaeological Impact Assessment (AIA) for the proposed construction of a 10 MW Concentrated Photovoltaic (CPV) Energy Generation Facility on the Remainder Farm 77 near Hopetown in the Northern Cape.

The study site for the proposed Disselfontein Solar Energy Plant is located alongside a gravel road, about 23 kms northwest of Hopetown. The Orange River is located about 1.5 kms to the east of the property. The site is fairly level. The western portion alongside the road is quite degraded and covered in dense stands of thorny acacia. The area across the eastern and northern portions, are literally infested with impenetrable Swarthok vegetation. There are several stream channels that intersect the site in the north and down the centre. Apart from existing Eskom infrastructure that includes several powerline servitudes, the Disselfontein substation, and gravel access road, there are no old buildings, structures or features within the footprint area.

In terms of Section 38 (1) (c) (iii) of the National Heritage Resources Act 1999 (Act 25 of 1999), an Archaeological Impact Assessment of the proposed project is required if the footprint area of the proposed development is more than 5000 m^2.

The AIA forms part of the Environmental Basic Assessment process that is being conducted by EnviroAfrica cc.

A 1-day, foot survey of the proposed 20 ha footprint area was undertaken by J. Kaplan on 5 March 2012, in which the following observations were made:

Thirty-two archaeological occurrences were recorded with a hand held GPS device. Most of the remains were found alongside the Eskom servitudes that cross the footprint area in several places. More than 95% of the tools are assigned to the Middle Stone Age (MSA), but a few Early Stone Age implements were also found that included several sub-bifaces and at least two handaxes. A range of different types of MSA flake and blade tools were counted, reflecting the range and variability of tools that occur in the Northern Cape Province. Most of the MSA lithics comprise triangular shaped flakes, chunks, retouched and utilised flakes and blades. Apart from a few chalcedony and chert flakes, more than 98% of the tools are in fine grained quartzite and weathered indurated shale. This is in stark contrast to several other proposed solar farms that were recently assessed by the archaeologist in the northern and western parts of the province, where the majority of the tools are almost exclusively in banded ironstone. Frequencies of formal retouched tools are low, and include only a few bifacial pointed flakes, and several retouched blades and points. No scrapers were found, but several side retouched flakes were counted, that could have been used as scraping tools. It is assumed that most of the pointed flakes were hafted onto shafts of wood and used as spears or stabbing tools.

As archaeological sites are concerned, the occurrences are lacking in context as no organic remains such as bone, pottery or ostrich eggshell was found. The relatively small numbers isolated and dispersed context in which they were found means that the remains have been rated as having low (Grade 3C) significance.

The results of the study indicate that the proposed development of the Disselfontein Solar Energy Plant will not have an impact of great significance on these and potentially other archaeological remains. The study has captured most of the archaeological heritage that is representative of the site.

Indications are that in terms of the archaeological heritage, the proposed activity is viable and no fatal flaws have been identified.

With regard to the proposed development of the Keren Energy Disselfontein Solar Energy Plant on Remainder Farm 77, the following recommendations are made:

1. No further archaeological mitigation is required.

2. Should any unmarked human burials/remains or ostrich eggshell caches be uncovered, or exposed during construction activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (SAHRA) (Att Ms Mariagrazia Galimberti 021 462 4502). Burials, etc must not be removed or disturbed until inspected by the archaeologist.

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1. INTRODUCTION

1.1 Background and brief

Keren Energy Disselfontein (Pty) Ltd appointed the Agency for Cultural Resource Management to conduct an Archaeological Impact Assessment (AIA) for the proposed construction of a 10 MW Concentrated Photovoltaic (CPV) Energy Generation Facility on Remainder Farm 77 near Hopetown in the Northern Cape (Figures 1 & 2).

The proposed development is situated within the Thembelihle Municipality. The subject property is zoned for Agriculture use and is owned by the J D Ferreira Family Trust.

The proposed development entails the construction of about 140 CPV solar panels covering a footprint area of 20 ha. The CPV panels will be mounted on pedestals drilled and set into the ground (Figure 3). Extensive bedrock excavations are not envisaged, but some vegetation will need to be cleared from the site. Associated infrastructure includes single track internal access roads, trenches for underground cables, transformer pads, a switching station, a maintenance shed, and a temporary construction camp. The electricity generated from the project will be fed into the national grid at the Eskom Disselfontein 132/22 Kv sub station which is situated on the proposed site, alongside the minor gravel road.

The AIA forms part of the Environmental Basic Assessment process that is being conducted by EnviroAfrica cc.

The aim of the study is to locate and map archaeological sites/remains that may be impacted by the proposed project, to assess the significance of the potential impacts and to propose measures to mitigate the impacts.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (Act No. 25 of 1999) makes provision for a compulsory Heritage Impact Assessment (HIA) when an area exceeding 5000 m^2 is being developed. This is to determine if the area contains heritage sites and to take the necessary steps to ensure that they are not damaged or destroyed during development.

The NHRA provides protection for the following categories of heritage resources:

- Landscapes, cultural or natural (Section 3 (3))
- Buildings or structures older than 60 years (Section 34);
- Archaeological sites, palaeontological material and meteorites (Section 35);
- Burial grounds and graves (Section 36);
- Public monuments and memorials (Section 37);

- Living heritage (defined in the Act as including cultural tradition, oral history, performance, ritual, popular memory, skills and techniques, indigenous knowledge systems and the holistic approach to nature, society and social relationships) (Section 2 (d) (xxi)).

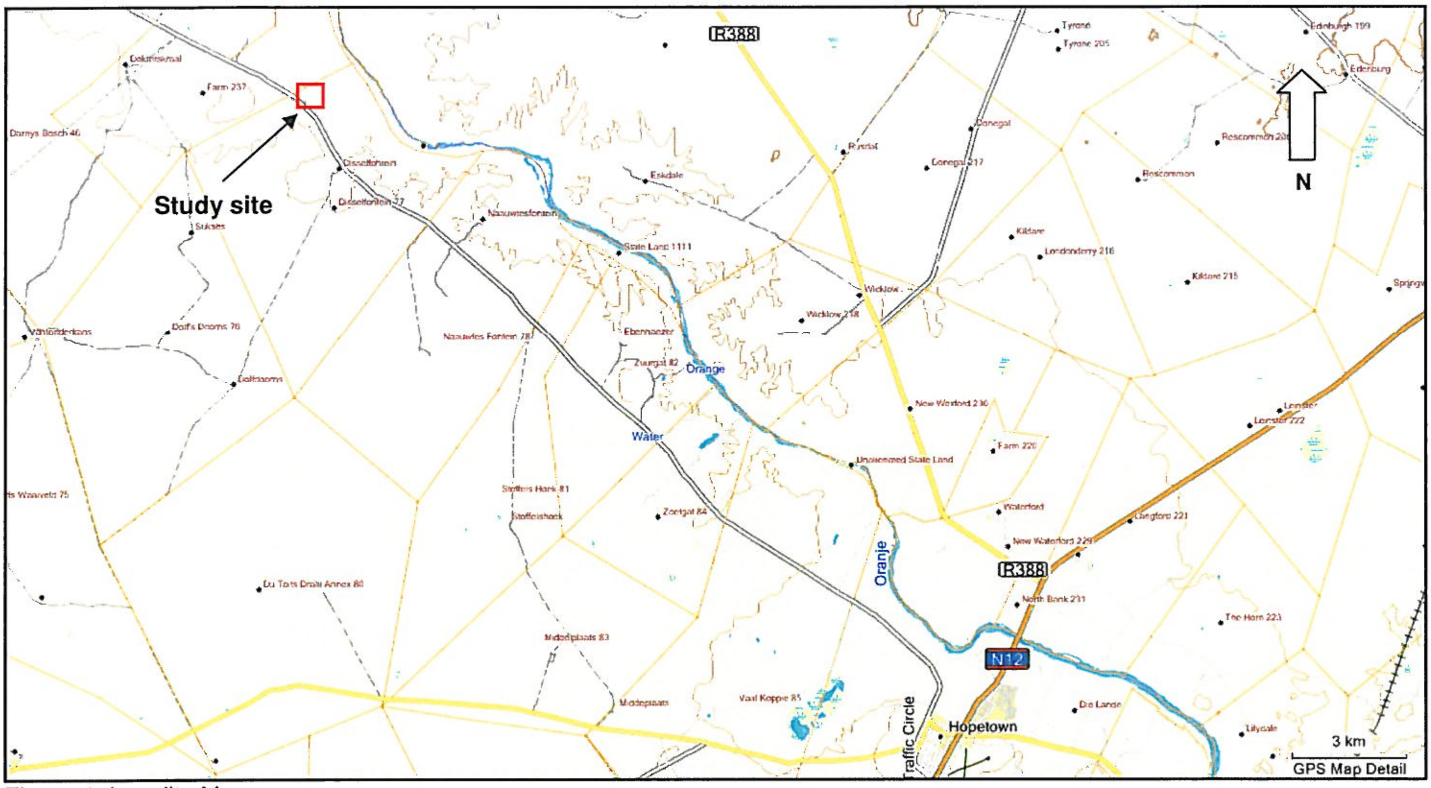

Figure 1. Locality Map

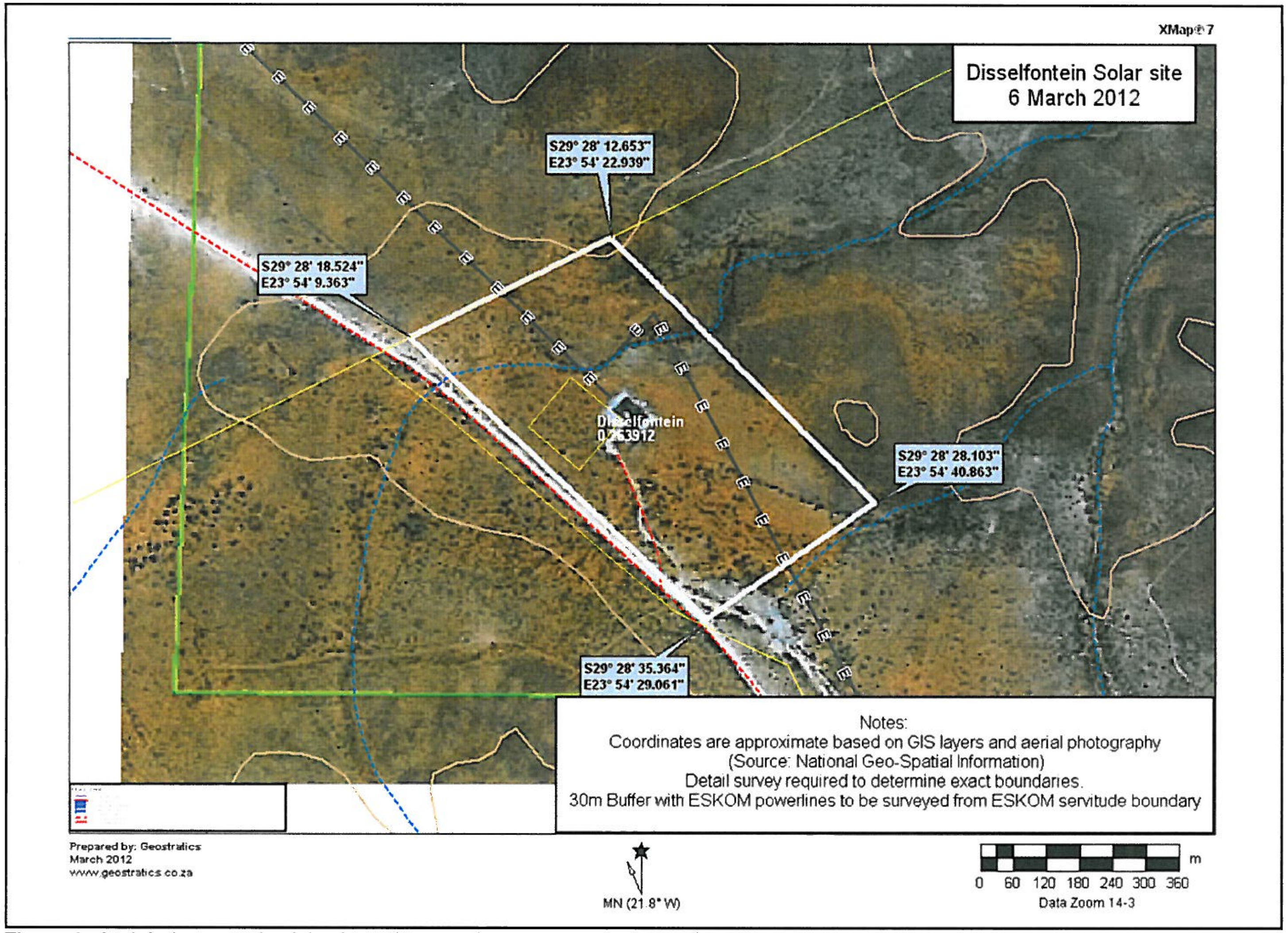

Figure 2. Aerial photograph of the footprint area for the proposed Disselfontein Solar Energy Plant

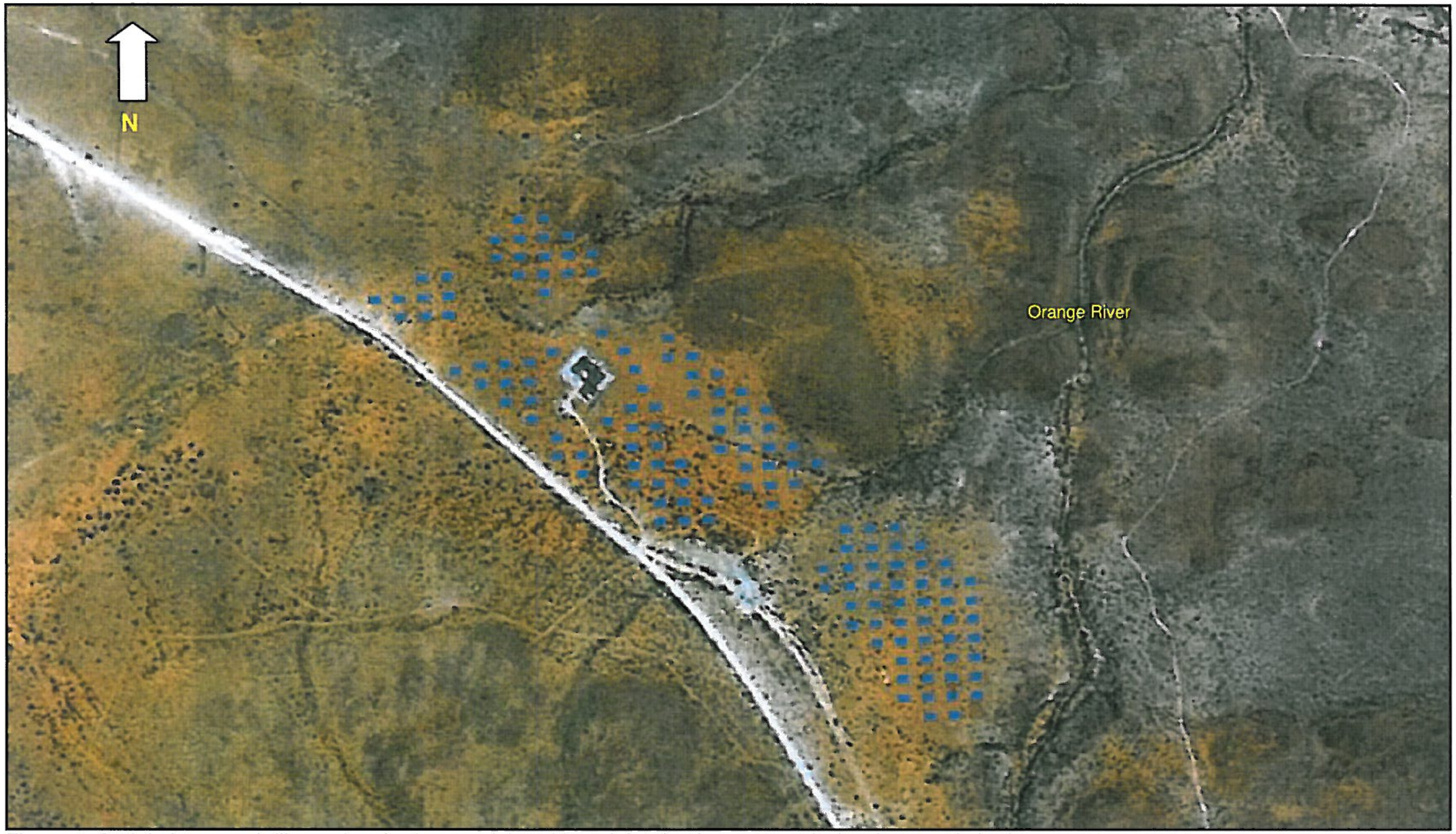

Figure 3. Aerial photograph illustrating the layout of the PV modules for the proposed Disselfontein Solar Energy Plant

3. TERMS OF REFERENCE

The terms of reference for the study were to:

- Determine whether there are likely to be any important archaeological resources that may potentially be impacted by the proposed project, including the erection of the solar panels, internal access roads, trenches for underground cables, and any other associated infrastructure;

- Indicate any constraints that would need to be taken into account in considering the development proposal;

- Identify potentially sensitive archaeological areas, and

- Recommend any further mitigation action.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

An aerial photograph indicating the location site of the proposed Disselfontein Solar Energy Plant is illustrated in Figure 4.

The proposed site is located about 23 kms northwest of Hopetown. Hopetown is about 150 kms southwest of Kimberly on the N12. The subject property is located alongside a minor gravel road, directly adjacent the Disselfontein substation. The Orange River is located about 1.5 kms to the east of the property. The proposed site is fairly level. A large swathe of grassland vegetation covers the central portion of the site (Figures 5 & 6), while the western portion alongside the gravel road is fairly degraded and covered in dense stands of thorny acacia with open spaces occurring in the north (Figure 7). The eastern and northern portions are overlain by shallow soils and extensive exposures of dolerite which are infested with extremely thick, thorny Swarthok vegetation (Figures 8 & 9). There are several non-perennial streams that intersect the site; in the north and one through the centre of the property alongside the Eskom servitude. There are no significant landscape features on or within the proposed footprint area. The land is currently zoned for agriculture. Surrounding land use is agriculture and vast tracks of vacant land. Centre pivots vegetation is extensive further south toward Hopetown. Apart from the Eskom infrastructure, there are no old buildings, structures, features, public memorials or monuments on or close to the proposed site.

There are no visible graves on the proposed site.

Figure 4. Location of the proposed Disselfontein Solar Energy Plant

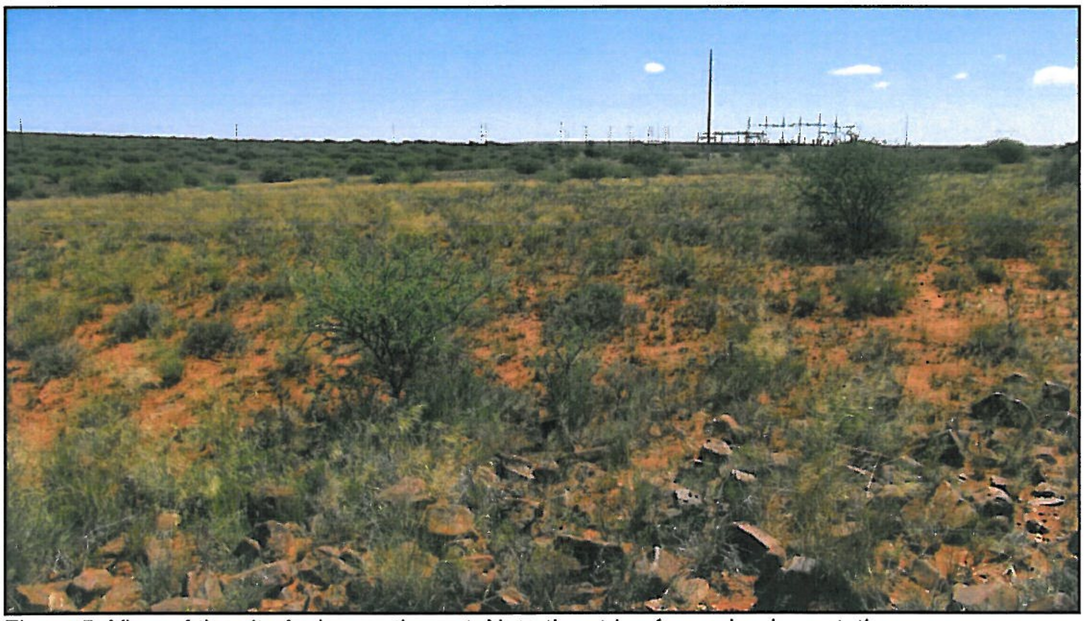
Figure 5. View of the site facing north west. Note the strip of grassland vegetation

Figure 6. View of the site facing south. Note the grassland vegetation and red sands alongside (i. e. east of) the drainage channel

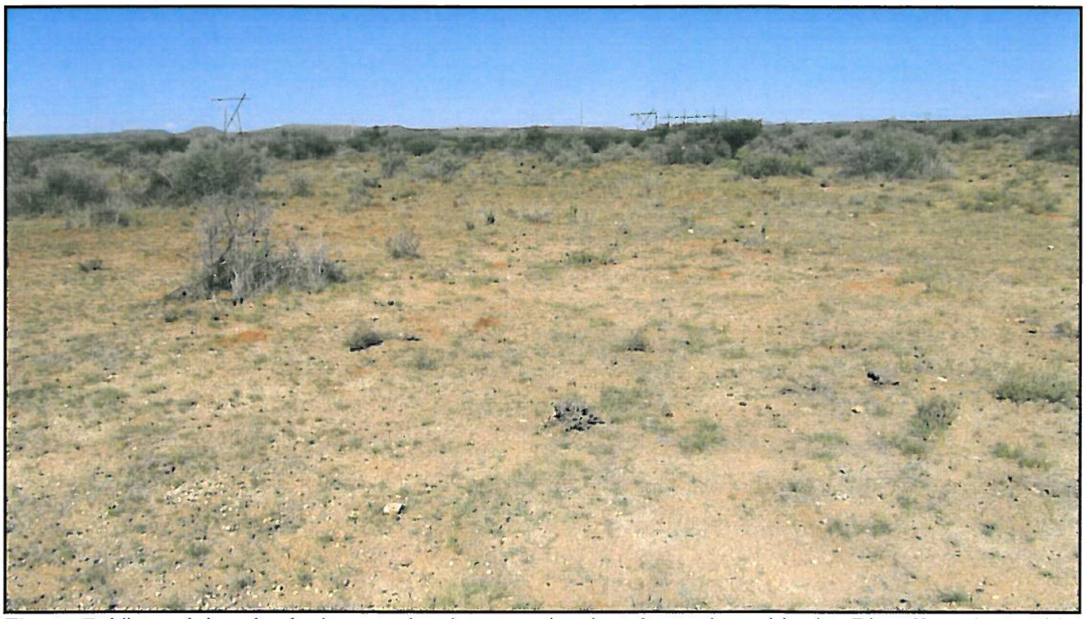

Figure 7. View of the site facing south. photograph taken from alongside the Disselfontein road in the far north western corner of the footprint area.

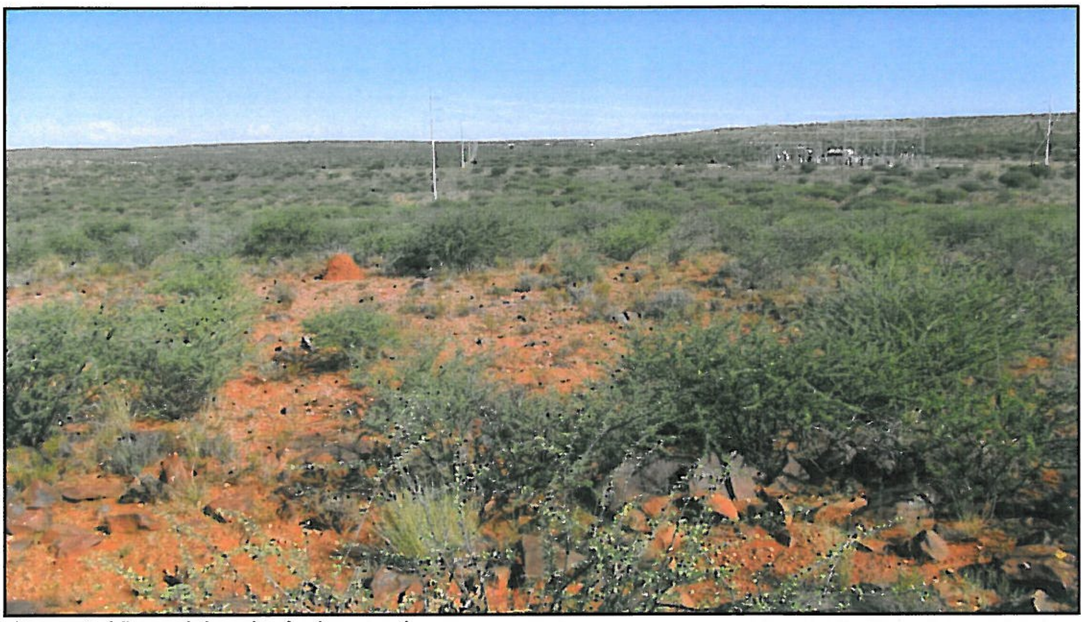

Figure 8. View of the site facing south

Figure 9. View of the site facing south. Note the dense Swarthok vegetation which covers a large portion of the footprint area

5. STUDY APPROACH

5.1 Method of survey

A ground survey of the proposed site was undertaken by J. Kaplan on 5 March, 2012. Archaeological occurrences were documented and mapped using a hand-held Garmin Oregon 300 GPS unit set on the map datum WGS 84.

A track path of the archaeological survey was also created (refer to Figure 10).

A desk top study was done.

5.2 Constraints and limitations

A large portion of the proposed site in the north and east is covered in extremely thorny and virtually impenetrable Swarthok vegetation, resulting in very poor archaeological visibility. Visibility alongside the western half was much better, even though portions of the site in the south are covered in dense stands of thorny acacia. Visibility was very good in the central portion, which is covered in grassland vegetation, where most of the archaeological remains were documented.

5.3 Identification of potential risks

Pre-colonial archaeological heritage (i. e. stone implements) will be impacted by the proposed development, but the numbers are relatively small and occur mostly within the Eskom servitude. Apart from trenches for underground cabling, limited bedrock excavations are envisaged. The solar panels will be raised about 2 m above ground and mounted on small footings drilled and set into the ground. The excavations for the footings are about 1-1.5 m in diameter and so the actual ground disturbance will be quite limited and contained.

5.4 Results of the desk top study

The archaeology of the Northern Cape is rich and varied covering long spans of human history. According to Beaumont et al (1995:240) "thousands of square kilometres of Bushmanland are covered by a low density lithic scatter". As far as can be established, no archaeological work has been done in Hopetown, but it is interesting to note that rock engravings have been recorded on Thomas' Farm about 30 kms from Hopetown on Kimberly-Hopetown road where a cache of buried ostrich eggshells, dating to possibly the late 19^{th} or early 20^{th} Century, were also excavated by Zoe Henderson (2001, 2002). According to Henderson, a late 19^{th} Century date would be consistent with the presence of San (Bushman) recorded by 19^{th} Century travellers to the interior.

Buried ostrich eggshell containers have also been uncovered on several farms in the Douglas area, about 70 kms north of Hopetown (Morris 2005). Such containers, some of them with mastic spouts were used to store water, as well as specularite which is a mineral pigment applied in cosmetic and ritual contexts (Morris 1992).

6. FINDINGS

Thirty-two archaeological occurrences were recorded with a hand held GPS device (Figure 10).

A spreadsheet and a description of the archaeological finds located during the study are also presented in Table 2 in Appendix I.

The majority of the remains occur in, and alongside the Eskom servitudes that cross the footprint area of the property in a number of places. These include a low density scatter of flakes and chunks west of the small stream (209 & 210), and several low density scatters to the east of the stream that cuts through the central portion of the site (211-22 & 222). Most of the archaeological remains were documented in this central area, on patches of stony ground and red sands, covered in grassland vegetation either side of a large Eskom servitude (refer to Figures 5 & 6).

A range of different types of implements were found on the site, reflecting the variability and range of tools that occur in the Northern Cape Province. Most of the tools are assigned to the Middle Stone Age (MSA), but a few ESA elements were also found, including two handaxes and several sub-biface tools (212, 216 & 221). Most of the MSA lithics comprise unmodified triangular shaped flakes, including chunks, retouched and utilised flakes, and a number of blades. At least seven round quartzite cores and two flat (prepared) quartzite cores were also found.

Apart from a few chalcedony/chert flakes, that included a very low density scatter of tools on a patch of orange sand in the eastern portion of the footprint area (238), more than 98% of the tools are in fine grained quartzite and weathered indurated shale. This is in stark contrast to several other proposed solar farms that were recently assessed by the archaeologist in the northern and western parts of the province, where the majority of the tools were almost exclusively in banded ironstone.

Frequencies of formal tools are low, and include a few bifacial pointed flakes, and partially retouched blades and points, including a large blade with step/adze retouch. It is assumed that most of the pointed flakes were hafted onto shafts of wood and used as spears or stabbing tools. No scrapers were found, but several side retouched flakes were noted, that could have been used as scraping tools. .

No organic remains such as pottery, bone or ostrich eggshell was found.

A collection of tools and the context in which some of them were found are illustrated in Figures 11-21.

No visible graves were found on the proposed site.

No rock engravings were found among numerous small outcroppings of dolerite that were searched alongside the northern boundary of the proposed site.

No old buildings, structures, or features, old equipment, public memorial or monuments occur in the footprint area.

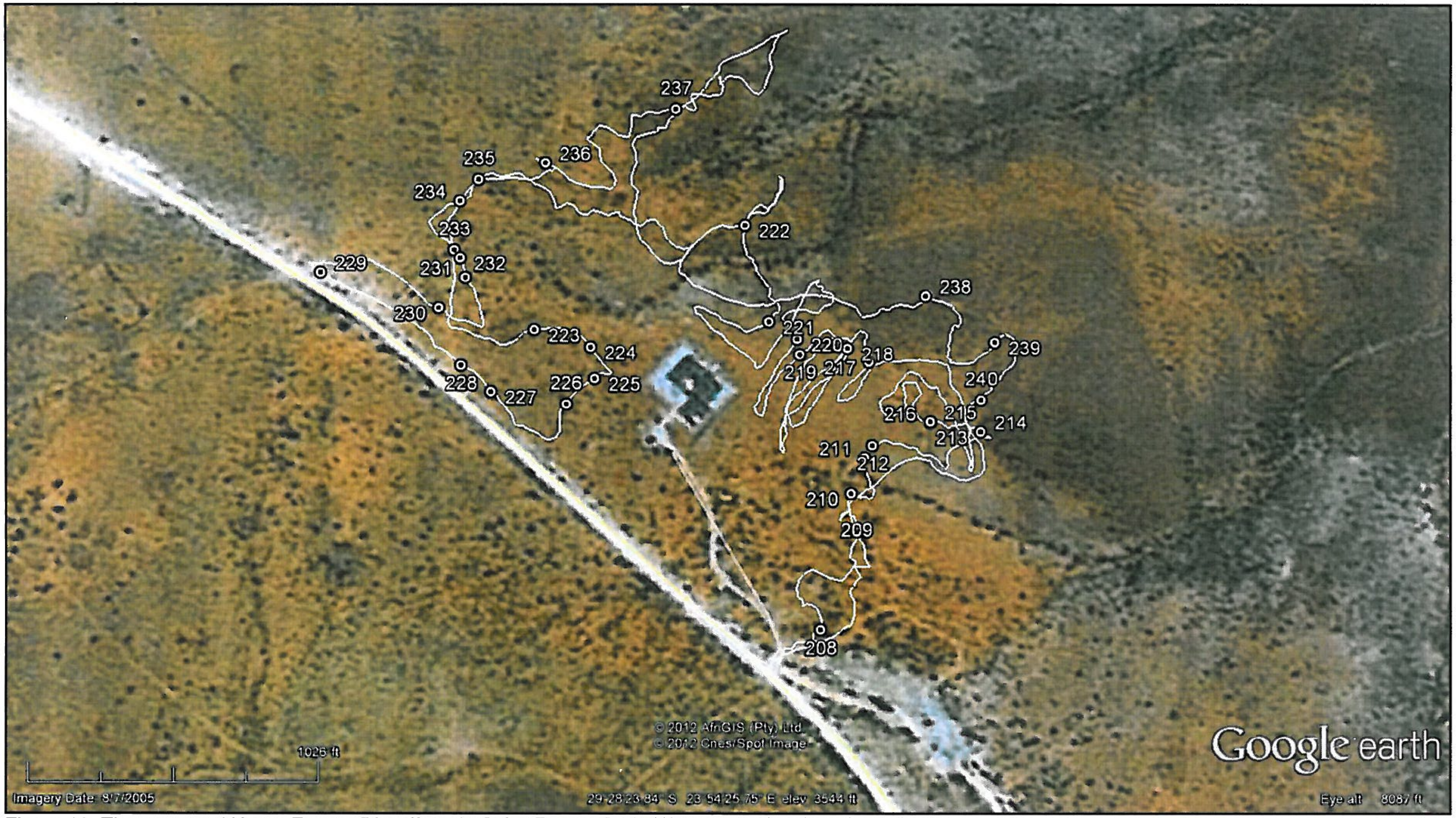

Figure 10. The proposed Keren Energy Disselfontein Solar Energy Park: Waypoints of archaeological finds

Figure 11. 209-210. Scale is in cm

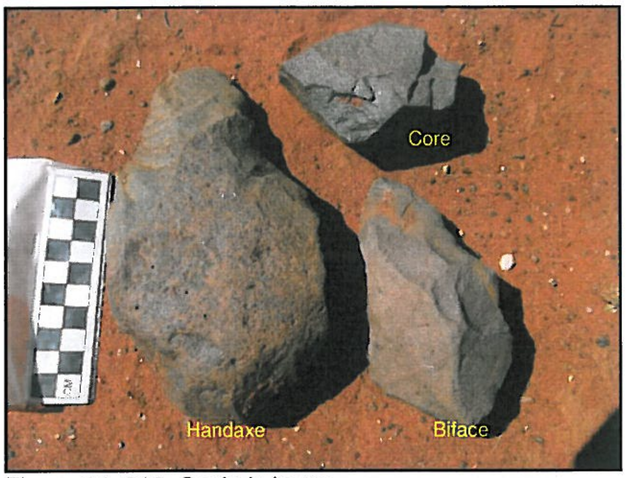

Figure 14. 216. Scale is in cm

Figure 12. 210. Context in which the remains were found

Figure 15. 217. Scale is in cm

Figure 13. 212. Scale is in cm

Figure 16. 216. Context in which the tools were found

Figure 17. 220 Context in which the tools were found

Figure 18. 211-220 & 222. Scale in cm

Figure 19. 211-220, & 222. Scale is in cm

Figure 20. 238. Scale is in cm

Figure 21. 238 context in which the tools were found

6.1 Significance of the archaeological remains

As archaeological sites are concerned, the occurrences are lacking in context as no organic remains such as bone, pottery or ostrich eggshell was found. The relatively small numbers isolated and dispersed context in which they were found mean that the remains have been rated as having low (Grade 3C) significance.

7. ASSESSMENT OF IMPACTS

In the case of the proposed Disselfontein Solar Energy Plant near Hopetown it is expected that the overall impact on important archaeological remains will be low (Table 1).

Apart from trenches for underground cables, limited bedrock excavations are envisaged. The solar panels will be raised about 2 m above ground and mounted on small footings drilled and set into the ground. The excavations for the footings are about 1.5 m in diameter and so the actual ground disturbance will be quite limited and contained

It is also important to note that the majority of the lithics were recorded in the Eskom servitudes.

Potential impacts on archaeological heritage	
Extent of impact:	Site specific
Duration of impact;	Permanent
Intensity	Low
Probability of occurrence:	Probable
Significance without mitigation	Low
Significance with mitigation	Negative
Confidence:	High

Table 1. Assessment of archaeological impacts.

8. CONCLUSION

It is maintained that development of the proposed Keren Energy Disselfontein Solar Energy Plant on Remainder Farm 77 will have a limited impact on archaeological heritage resources.

The AIA has captured most of the archaeological heritage that is present on the site, although it should be remembered that a large portion of the footprint area is covered in dense Swarthok vegetation.

Indications are, however, that in terms of the archaeological heritage, the proposed activity is viable and no fatal flaws have been identified.

9. RECOMMENDATIONS

With regard to the proposed construction and operation of the Keren Energy Disselfontein Solar Energy Plant on Remainder Farm 77 near Hopetown, the following recommendations are made:

1. No further archaeological mitigation is required.

2. Should any unmarked human burials/remains or ostrich eggshell caches be uncovered, or exposed during construction activities, these must immediately be reported to the archaeologist (Jonathan Kaplan 082 321 0172), or the South African Heritage Resources Agency (SAHRA) (Att Ms Mariagrazia Galimberti 021 462 4502). Burials must not be removed or disturbed until inspected by the archaeologist.

10. REFERENCES

Beaumont, P.B. & Vogel, J.C. 1984. Spatial patterning of the ceramic Later Stone Age in the Northern Cape Province, South Africa. In: Hall, M., Avery, G., Avery, D.M., Wilson, M.L. & Humphreys, A.J.B. (Eds) Frontiers: southern African archaeology today: 80-95. Oxford: British Archaeological Reports International Series 207.

Henderson, Z. 2002. A dated cache of ostrich-eggshell flasks from Thomas` Farm, Northern Cape Province, South Africa. South African Archaeological Bulletin 57:38-40

Morris, D. 2005. Further evidence of spouts on ostrich eggshell containers from the Northern Cape, with a note on the history of anthropology and archaeology at the McGregor Museum, Kimberley. South Africa Archaeological Bulletin 60:112-114

Morris, D. 2002. Another spouted ostrich eggshell container from the Northern Cape, South African Archaeological Bulletin 57:41

Appendix I

238		S29 28.328 E23 54.565	3-4 chert flakes and 2-3 MSA quartzite flakes on small patch of gravel/sand surrounded by dolerite outcropping
239		S29 28.356 E23 54.612	X 2 MSA quartzite flakes in small footpath
240		S29 28.391 E23 54.603	MSA quartzite flake

Table 2. The proposed Disselfontein Solar Energy Plant: spreadsheet of waypoints and description of archaeological finds

APPENDIX D3B PALAEONTOLOGICAL

PALAEONTOLOGICAL HERITAGE: COMBINED DESKTOP STUDY & PHASE 1 FIELD ASSESSMENT

PROPOSED DISSELFONTEIN KEREN SOLAR PLANT NEAR HOPETOWN, NORTHERN CAPE

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May 2012

1. SUMMARY

Keren Energy Disselfontein (Pty) Ltd is proposing to develop a 10 MW capacity solar energy facility on the Remainder of Farm 77, Hopetown, Northern Cape. The study site for the Disselfontein Keren Solar Plant is located 23.5 km NW of Hopetown and close to the western banks of the Orange River.

Potentially fossiliferous rock units within the broader Hopetown - Douglas study region include Early Permian marine sediments of the lowermost Ecca Group (Prince Albert Formation) as well as Tertiary fluvial gravels of the Orange River. However, field assessment shows that neither of these rock units is represented within the Disselfontein study area, which is largely mantled by various superficial deposits (surface gravels, calcretes, aeolian sands) of low to very low palaeontological sensitivity. The only Karoo Supergroup rocks present are unfossiliferous glacial tillites that are additionally deeply weathered and calcretised.

It is concluded that the proposed Disselfontein Keren Solar Plant project does not pose a significant threat to local fossil heritage resources. Should substantial fossil remains (*e.g.* petrified wood, vertebrate bones and teeth) be exposed during development, these should be safeguarded, preferably *in situ*, and reported by the ECO to SAHRA so that appropriate recording or mitigation measures can be considered.

2. OUTLINE OF DEVELOPMENT

Keren Energy Disselfontein (Pty) Ltd is proposing to construct a 10 MW Concentrating Photovoltaic (CPV) Energy Generation Facility, the Disselfontein Keren Solar Plant, on a site (Remainder of Farm 77, Hopetown) close to the Orange River and 23.5 km northwest of Hopetown, Northern Cape (Figs. 1 & 13). The land is currently zoned for agriculture.

The proposed activity entails the construction of about 140 CPV solar panels with a footprint of about 20 ha. The CPV panels will be mounted on pedestals drilled and set into the ground. Extensive bedrock excavations are not envisaged, but some vegetation will need to be cleared from the site. Associated infrastructure includes a perimeter access road, single track internal access roads, trenches for underground cables, 2 to 4 transformer pads, a switching station, a maintenance shed, and a temporary construction camp. Connection with the grid will be *via* the Disselfontein 132 / 22kV substation that is situated on site.

The present combined desktop and field-based palaeontological heritage assessment has been commissioned by EnviroAfrica cc, Somerset West as part of a comprehensive Heritage Impact

Assessment of the proposed development (Contact details: Mr Bernard de Witt, EnviroAfrica cc, P. O. Box 5367, Helderberg, 7135; 29 St James St, Somerset West; mobile: +27 82 4489991; tel: +27 21 851 1616; fax: 086203308). This report augments an earlier desktop study for this project completed by the author in March 2012.

2.1. National Heritage Resources Act

The extent of the proposed development (over 5000 m^2) falls within the requirements for a Heritage Impact Assessment (HIA) as required by Section 38 (Heritage Resources Management) of the South African National Heritage Resources Act (Act No. 25 of 1999). The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

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

Minimum standards for the palaeontological component of heritage impact assessment reports are currently being developed by SAHRA. The latest version of the SAHRA guidelines is dated August 2011.

2.2. Approach used for this palaeontological study

This report provides an assessment of the observed or inferred palaeontological heritage within the Disselfontein study area, with recommendations for any specialist palaeontological mitigation where this is considered necessary. The report is based on (1) a review of the relevant scientific literature, (2) geological maps, (3) previous palaeontological heritage assessments for alternative energy and other developments in the region (*e.g.* Almond 2010), (4) the author's field experience with the formations concerned and their palaeontological heritage, and (5) a one-day field assessment on 27 April 2012 carried out by the author.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc*) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (Consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to development (Provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by J. Almond and colleagues; *e.g.* Almond & Pether 2008). The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature of the development itself, most notably the extent of fresh bedrock excavation envisaged.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field assessment study by a professional palaeontologist is usually warranted. Most detrimental impacts on palaeontological heritage occur during the construction phase when fossils may be disturbed, destroyed or permanently sealed-in during excavations and subsequent construction activity. Where specialist palaeontological mitigation is recommended, this may take place before construction starts or, most effectively, during the construction phase while fresh, potentially fossiliferous bedrock is still exposed for study. Mitigation usually involves the judicious sampling, collection and recording of fossils as well as of relevant contextual data concerning the surrounding sedimentary matrix. It should be emphasised that, *provided* appropriate mitigation is carried out, many developments involving bedrock excavation actually have a *positive* impact on our understanding of local palaeontological heritage. Constructive collaboration between palaeontologists and developers should therefore be the expected norm.

The focus of the field-based assessment work is *not* simply to survey the development footprint or even the development area as a whole (*e.g.* farms or other parcels of land concerned in the development). Rather, the palaeontologist seeks to assess or predict the diversity, density and distribution of fossils within and beneath the study area, as well as their heritage or scientific interest. This is primarily achieved through a careful field examination of one or more representative exposures of all the sedimentary rock units present (*N.B.* Metamorphic and igneous rocks rarely contain fossils). The best rock exposures are generally those that are easily accessible, extensive, and fresh (*i.e.* unweathered) and include a large fraction of the stratigraphic unit concerned (*e.g.* formation). These exposures may be natural or artificial and include, for example, rocky outcrops in stream or river banks, cliffs, quarries, dams, dongas, open building excavations or road and railway cuttings. Uncemented superficial deposits, such as alluvium, scree or wind-blown sands, may occasionally contain fossils and should also be included in the scoping study where they are well-represented in the study area. It is normal practice for impact palaeontologists to collect representative, well-localized (*e.g.* GPS and stratigraphic data) samples of fossil material during field assessment studies. However, fossil collection should be supported by a permit from the relevant heritage heritage authority and all fossil material collected must be properly curated within an approved repository (usually a museum or university collection).

Before fieldwork commenced, a preliminary screening of satellite images and 1: 50 000 maps of the Disselfontein study area was conducted to identify any sites of potentially good bedrock exposure to be examined in the field. These sites might include, for example, natural exposures (*e.g.* stream beds, rocky slopes, stream gullies) as well as artificial exposures such as quarries, dams and cuttings along farm tracks.

Note that while fossil localities recorded during fieldwork within the study area itself are obviously highly relevant, most fossil heritage here is embedded within rocks beneath the land surface or obscured by surface deposits (soil, alluvium *etc*) and by vegetation cover. In many cases where levels of fresh (*i.e.* unweathered) bedrock exposure are low, the hidden fossil resources have to be *inferred* from palaeontological observations made from better exposures of the same formations elsewhere in the region but outside the immediate study area. Therefore a palaeontologist might reasonably spend far *more* time examining road cuts and borrow pits close to, but outside, the study area than within the study area itself. Field data from localities even further afield (*e.g.* an adjacent province) may also be adduced to build up a realistic picture of the likely fossil heritage within the study area.

On the basis of the desktop and field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) – is usually most effective during the construction phase when fresh fossiliferous bedrock has been exposed by excavations, although pre-construction recording of surface-exposed material may sometimes be more appropriate. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority (*i.e.* SAHRA, Cape Town). It should be emphasized that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

GPS data for all localities mentioned in the text is provided in the Appendix.

2.3. Assumptions & limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g.* of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

(a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

(b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

Conditions for assessing the palaeontological sensitivity of the Disselfontein study area during the one day field visit were good. Vegetation cover is fairly low, and there is sufficient exposure of both bedrock units and superficial sediments in the area.

3. GEOLOGICAL BACKGROUND

The proposed Disselfontein Keren solar plant study area (29° 28' S, 23° 53' E) is situated on the eastern side of a minor dust road 23.5 km to the northwest of Hopetown, Northern CApe. The site is flat-lying at an elevation of *c.* 1080m amsl, some 50 m above the Orange River that flows 1.5 km to the northeast. Several small incised stream beds cross the site, draining to the northeast (Fig. 13).

The geology of the study area near Hopetown is shown on the 1: 250 000 geology map 2922 Prieska (Council for Geoscience, Pretoria; Fig. 1 herein). The explanation for the Prieska geological map has not yet been published and therefore critical details of the local stratigraphy relevant to the present impact study remain ambiguous. However, several of the rock units are treated in some detail in the explanations for the Britstown sheet to the south (Prinsloo, 1989) and the Koffiefontein sheet to the east (Zawada,1992).

The banks of the Orange River Valley in this region are underlain by ancient Precambrian lavas of the **Ventersdorp Supergroup** (**Allanridge Formation, Ra**) of Late Archaean age (*c.* 2.7 billion years old).This Late Archaean succession is almost entirely composed of resistant-weathering, dark green lavas and associated pyroclastic rocks that are dated to 2.7 Ga (Bosch 1993, Van der Westhuizen & De Bruiyn 2006 and refs. therein). Thin lenses of cross-bedded quartzite and conglomerate are recorded just above the base of the succession by Bosch (1993).

The Ventersdorp Group basement rocks are unconformably overlain by glacially-related sediments of the **Mbizane Formation** (**Dwyka Group, C-Pd**). The Mbizane Formation, up to 190m thick, is recognized across the entire northern margin of the Main Karoo Basin where it may variously form the whole or only the *upper* part of the Dwyka succession. It is characterized by its extremely heterolithic nature, with marked vertical and horizontal facies variation (Von Brunn & Visser 1999). The proportion of diamictite and mudrock is often low, the former often confined to basement depressions. Orange-tinted sandstones (often structureless or displaying extensive soft-sediment deformation, amalgamation and mass flow processes) may dominate the succession. The Mbizane-type heterolithic successions characterize the thicker Dwyka of the ancient palaeovalleys cutting back into the northern basement rocks. A number of **glacial pavements** – *i.e.* areas of glacially-striated and eroded bedrocks - of Dwyka age (*i.e.* Permo-Carboniferous, *c.* 300 Ma) are recorded from the Kimberley – Douglas region. These features, which here indicate consistent ice transport directions to the southwest, are of geological conservation significance.

Basinal sediments of the Lower Ecca Group are not separately mapped in the Douglas area on the 1:250 000 geology sheet 2922 Prieska, probably for reasons of scale. However, it is clear from detailed studies of the upper Dwyka succession near Douglas by McLachlan and Anderson (1973) as well as Von Brunn and Visser (1999) *plus* the more regional account of the Lower Karoo succession in the Kimberley – Britstown area by Visser *et al.* (1977-78) that the Dwyka Group is at least locally overlain here by laminated mudrocks of the **Prince Albert Formation** of the **Ecca Group**. This unit of Early Permian (Asselian / Artinskian) age was previously known as "Upper Dwyka Shales". Key geological accounts of this formation are given by Visser (1992) and Cole (2005). The Prince Albert Formation in the Kimberley - Britstown area consists predominantly of well-laminated basinal mudrocks (shales, siltstones) that are sometimes carbonaceous or pyritic and typically contain a variety of diagenetic concretions enriched in iron and carbonate minerals. Some of these carbonate concretions are richly fossilferous (Almond 2010 and refs. therein).

The Precambrian basement lavas and overlying Karoo Supergroup rocks within the study area are mantled with various Late Caenozoic **superficial deposits**. Relict patches of **terrace gravels** ("High Level Gravels") are mapped on the north-eastern side of the study area (medium yellow with double "flying bird" symbol in Fig. 1) but their status is problematic (see discussion below). These ancient elevated alluvial gravels are of uncertain age, perhaps Plio-Pleistocene (last 5 Ma) or maybe even older (Miocene; *cf* Almond 2009). **Quaternary sands** (**Qs**) mapped here may be aeolian in original and provisionally assigned to the **Gordonia Formation** of the **Kalahari Group**.

Following the initial desktop study the main focus of the palaeontological field assessment was to determine whether or not potentially fossiliferous sediments of (1) the lowermost Ecca Group (Prince Albert Formation) or (2) Tertiary alluvial gravels ("High Level Gravels") were represented within the study area.

Fine-grained, grey-green lavas of the Allanridge Formation are exposed in stream incisions to the north of the Disselfontein substation (Fig. 2). The lavas are generally massive, but locally vuggy (with irregular cavities) or vesicular (bubbly texture) to amygdaloidal (with secondarily infilled gas bubbles). Quartzite beds were not observed *in situ* within the Allanridge succession but may well be present here, judging from the abundance of quartzite gravel clasts locally. The low hilly area along the eastern edge of the study area is mantled not with High Level Gravels (*cf* Fig. 1) but with monomict, coarse, blocky surface gravels generated by *in situ* weathering and downwasting of the well-jointed Allanridge bedrocks (Fig. 7). Between the angular to subrounded lava blocks are finer, more polymict gravels of quartzite, vein quartz and lava embedded in or overlying orange-hued Kalahari sands and calcrete (Fig. 8). Occasional well-rounded river cobbles and pebbles are found, but these are very sparse and no substantial High Level Gravels attributable to the Orange River appear to be preserved here.

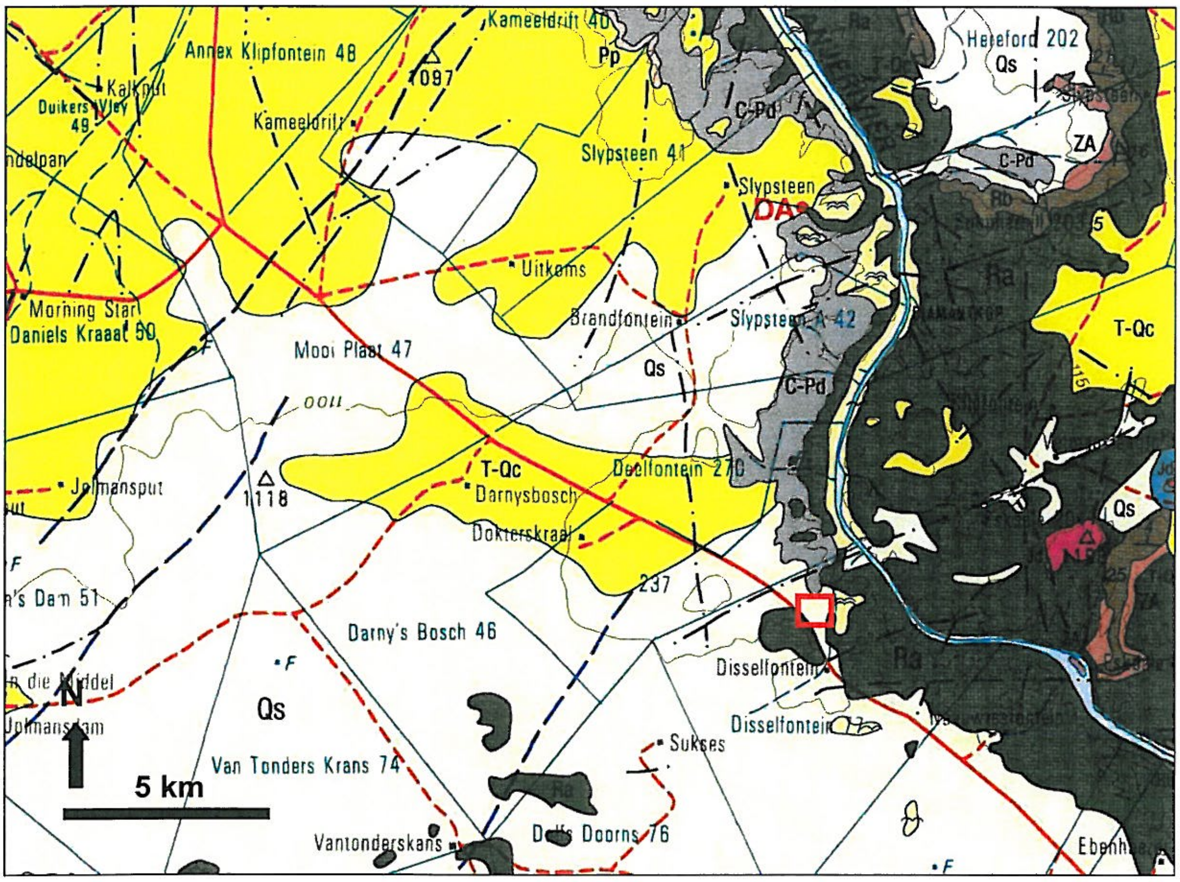

Fig. 1. Extract from 1: 250 000 geological map 2922 Prieska (Council for Geoscience, Pretoria) showing approximate location of proposed Disselfontein Keren Solar Plant study area some 1.5 km from the Orange River and 23.5 km to the NW of Hopetown, Northern Cape Province (small red rectangle). The study area is underlain at depth by Precambrian (Late Archaean) lavas of the Ventersdorp Group (Ra – dark green: Allanridge Formation) and/ or glacial or post-glacial sediments of the basal Karoo Supergroup (C-Pd - grey: Mbizane or Prince Albert Formations). In this region the basement lavas and Karoo sediments are largely overlain by Quaternary sands (Qs – pale yellow) and / or ancient river gravels of the Orange River (yellow with two flying –bird symbols).

Much of the western portion of the study area appears to be underlain at depth by grey boulder mudstones or tillites of the Dwyka Group. Over much of the area these are mantled by superficial deposits, but good exposures are seen in the sizeable quarry at the southern edge of the study area (Loc. 494). The Dwyka sediments here are massive to bedded with sparse to concentrated boulder-sized and smaller erratics of various exotic and local rock types (Fig. 3). Scattered lenticles of grey-brown diagenetic carbonate, often calcrete-coated, are present. The Dwyka rocks are weathered and pervasively calcretised for a depth of up to several meters (Figs. 4 & 5). No evidence of dark, laminated basinal mudrocks of the Prince Albert Formation (lowermost Ecca Group) was seen here.

The Dwyka outcrop area is capped by a pale cream to whitish calcrete hardpan, massive to crudely bedded and up to two meters or more thick (Fig. 10). The calcretes contain abundant embedded gravel clasts up to boulder size that originally downwasted from the Dwyka bedrocks below. The upper surface of the calcrete is usually mantled with coarse polymict gravels, angular to subrounded, that have in turn eroded out of the underlying hardpan (Fig. 5). The irregular contact between the hardpan and overlying orange-brown gravelly soils suggests one or more episodes of karstic weathering with pothole and doline formation (Fig. 10). Bedded units of angular grey mudrock chips (probably of Dwyka provenance) as well as lenticles of poorly-sorted but occasionally well-rounded gravels are seen within or above the calcretes, suggesting local fluvial input. Artificially flaked quartzite clasts are quite common within the subsurface gravels, implying a Pleistocene or later age (Fig. 6). The calcretes and gravels are variously mantled by reddish-brown gravelly soils, finer brown soils or Kalahari sands. Shallow stream bed exposures of subsurface calcrete and coarse gravels are seen at Loc. 498 (Fig. 11).

The flat area to the northeast of the Disselfontein substation is mantled with polymict surface gravels, including clasts of lava, quartzite, chert and abundant calcrete (Fig. 9). Numerous well-rounded clasts point to a substantial fluvial component, modified by downwasting.

Orange-hued Kalahari sands (probably Gordonia Formation equivalents) are well seen in the western portion of the study area (Fig. 12). Stream incision indicates sand thicknesses of several meters or more, thickening westwards away from the Orange River. The sands contain thin fine gravels (*e.g.* calcrete chips) and sparse boulders of probable Dwyka or Allanridge provenance.

Fig. 2. Stream incision into greenish-grey, blocky-jointed lavas of the Allanridge Formation to the north of substation (Loc. 496).

Fig. 3. Good quarry exposure of massive to thin-bedded grey Dwyka tillites with brownish diagenetic carbonate lenses (bottom LHS), sparse boulder-sized erratics and mantle of calcrete, well-bedded reddish-brown gravels and sandy soils (Loc. 494).

Fig. 4. Weathered and secondarily calcretised Dwyka Group tillites containing boulder-sized erratics and capped by reddish-brown gravelly soils (Loc. 494).

Fig. 5. Detail of upper, pervasively calcretised Dwyka Group sediments, overlying reddish-brown gravels and brown surface soils (Loc. 494) (Hammer = 27 cm.).

Fig. 6. Poorly sorted gravel lens overlying Dwyka outcrop. Clasts vary from angular to well-rounded and several are flaked (arrows), suggesting a Pleistocene or younger age (Loc. 494) (Hammer = 27 cm).

Fig. 7. Angular blocky surface gravels overlying the outcrop area of the Allanridge Formation on the eastern edge of the study area. These surface deposits, generated by *in situ* weathering and downwasting, appear to be mapped as fluvial High Level Gravels in Fig. 1.

Fig. 8. Finer gravels on surface between the large blocks seen in the previous figure (Scale in cm). Gravels here consist of Allanridge lavas, vein quartz and quartzite (many of the quartzite clasts are flaked) overlying orange-brown Kalahari sands.

Fig. 9. Polymict surface gravels in the flat area due NE of the substation. Note some well-rounded clasts of probably fluvial origin as well as abundant reworked pale calcrete fragments (Loc. 497).

Fig. 10. Secton through thick calcrete hardpan capping the Dwyka outcrop area. The irregular undulating contact with overlying reddish brown gravelly soils suggests karstic solution weathering (Loc. 494).

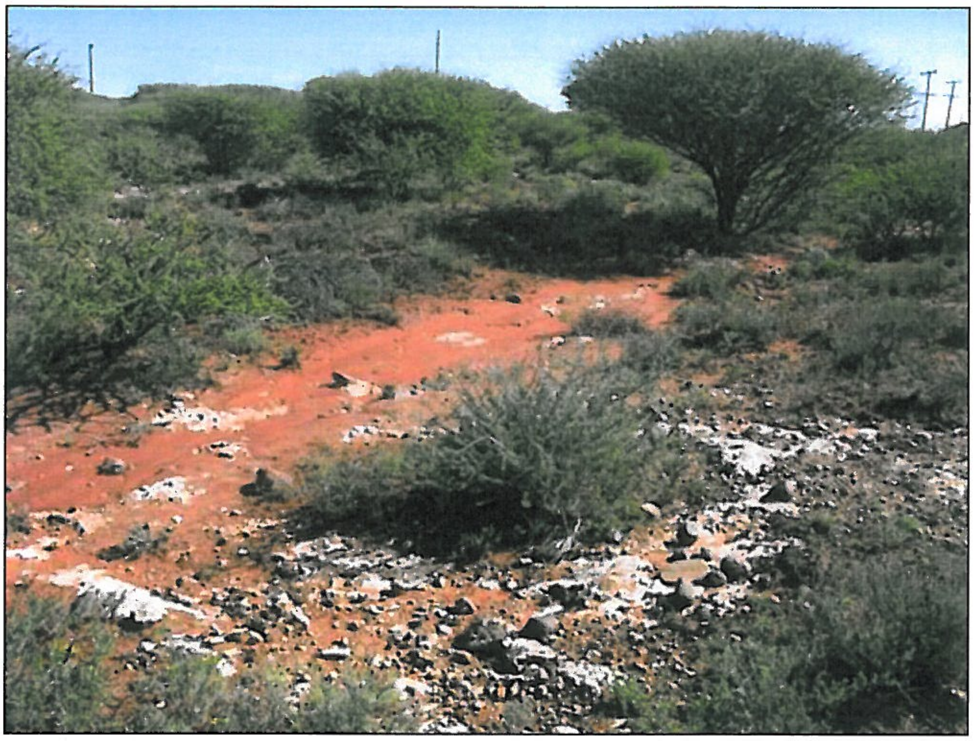

Fig. 11. Shallow stream incision through surface Kalahari sands to expose pale calcretes and downwasted coarse gravels beneath (Loc. 498).

Fig. 12. Deep orange-hued Kalahari aeolian (wind-blown) sands mantling the western portion of the study area.

4. PALAEONTOLOGICAL HERITAGE

The Precambrian **Allanridge Formation** (Ventersdorp Group) lavas are not palaeontologically sensitive. However, well-preserved glacial pavements that are sometimes incised into these ancient rocks record the movement of the Dwyka ice sheets across the area some 300 million years ago and warrant recording and protection as geo-conservation sites. No glacial pavements were noted during the field assessment.

Sparse, low diversity fossil biotas from the **Mbizane Formation** (Dwyka Group) mainly consist of arthropod trackways associated with dropstone laminites and sporadic vascular plant remains (drifted wood and leaves of the *Glossopteris* Flora), while palynomorphs (organic-walled microfossils) are also likely to be present within finer-grained mudrock facies (Almond 2008, 2009, 2010). Glacial diamictites (tillites or "boulder mudstones") are normally unfossiliferous but do occasionally contain fragmentary transported plant material as well as palynomorphs in the fine-grained matrix.

The most diverse as well as biostratigraphically, palaeobiogeographically and palaeoecologically interesting fossil biota from the **Prince Albert Formation** (Ecca Group) is that described from calcareous concretions exposed along the Vaal River in the Douglas area of the Northern Cape. The most famous localities are known as Zand Bult and Blaauw Kranz, situated *c.* 55 km north of the study area (McLachlan and Anderson 1973, Visser *et al.,* 1977-78). The important Douglas biota contains petrified wood (including large tree trunks), palynomorphs (miospores), orthocone nautiloids, nuculid bivalves, articulate brachiopods, spiral and other "coprolites" (probably of fish, possibly including sharks) and fairly abundant, well-articulated remains of palaeoniscoid fish. Most of the fish have been assigned to the palaeoniscoid genus *Namaichthys* but additional taxa, including a possible acrolepid, may also be present here. The invertebrates are mainly preserved as moulds.

Field assessment of the Disselfontein study area found no evidence of Lower Ecca sediments above the Dwyka Group outcrop area. The Dwyka sediments are dominated by massive tillites, are deeply weathered and probably unfossiliferous.

Alluvial gravels of the Orange River of Miocene and younger, Plio-Pleistocene age are locally highly fossiliferous (*e.g.* Hendy 1984, Schneider & Marias 2004, Almond 2009 and extensive references therein). Important fossil elements include a wide range of large to small mammals, reptiles (*e.g.* crocodiles, tortoises), freshwater molluscs, trackways and petrified wood. The "High Level Gravels" along the Vaal River have likewise yielded important fossil assemblages of Plio-Pleistocene age (Almond 2010 and references therein).

Aeolian sands of the **Gordonia Formation** dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from the underlying Dwyka Group may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands (Du Toit 1954, Dingle *et al.*, 1983). These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low.

There is no evidence for well-preserved ancient alluvial gravels of the Orange River within the study area. No fossil remains were observed among the surface gravels or within the other superficial deposits noted on site.

5. CONCLUSIONS & RECOMMENDATIONS

Potentially fossiliferous rock units within the broader Hopetown - Douglas study region include Permian marine sediments of the lowermost Ecca Group (Prince Albert Formation) as well as Tertiary fluvial gravels of the Orange River. However, field assessment shows that neither of these rock units is represented within the Disselfontein study area, which is largely mantled by various superficial deposits (surface gravels, calcretes, aeolian sands) of low to very low palaeontological sensitivity. The only Karoo Supergroup rocks present are unfossiliferous glacial tillites that are additionally deeply weathered and calcretised.

It is concluded that the proposed Disselfontein Keren Solar Plant project does not pose a significant threat to local fossil heritage resources. Should substantial fossil remains (*e.g.* petrified wood, vertebrate bones and teeth) be exposed during development, these should be safeguarded, preferably *in situ*, and reported by the ECO to SAHRA so that appropriate recording or mitigation measures can be considered.

6. ACKNOWLEDGEMENTS

Mr Bernard de Witt of EnviroAfrica cc, Somerset West is thanked for commissioning this study. I am very grateful to Ms Madelon Tusenius for assistance with GPS data handling.

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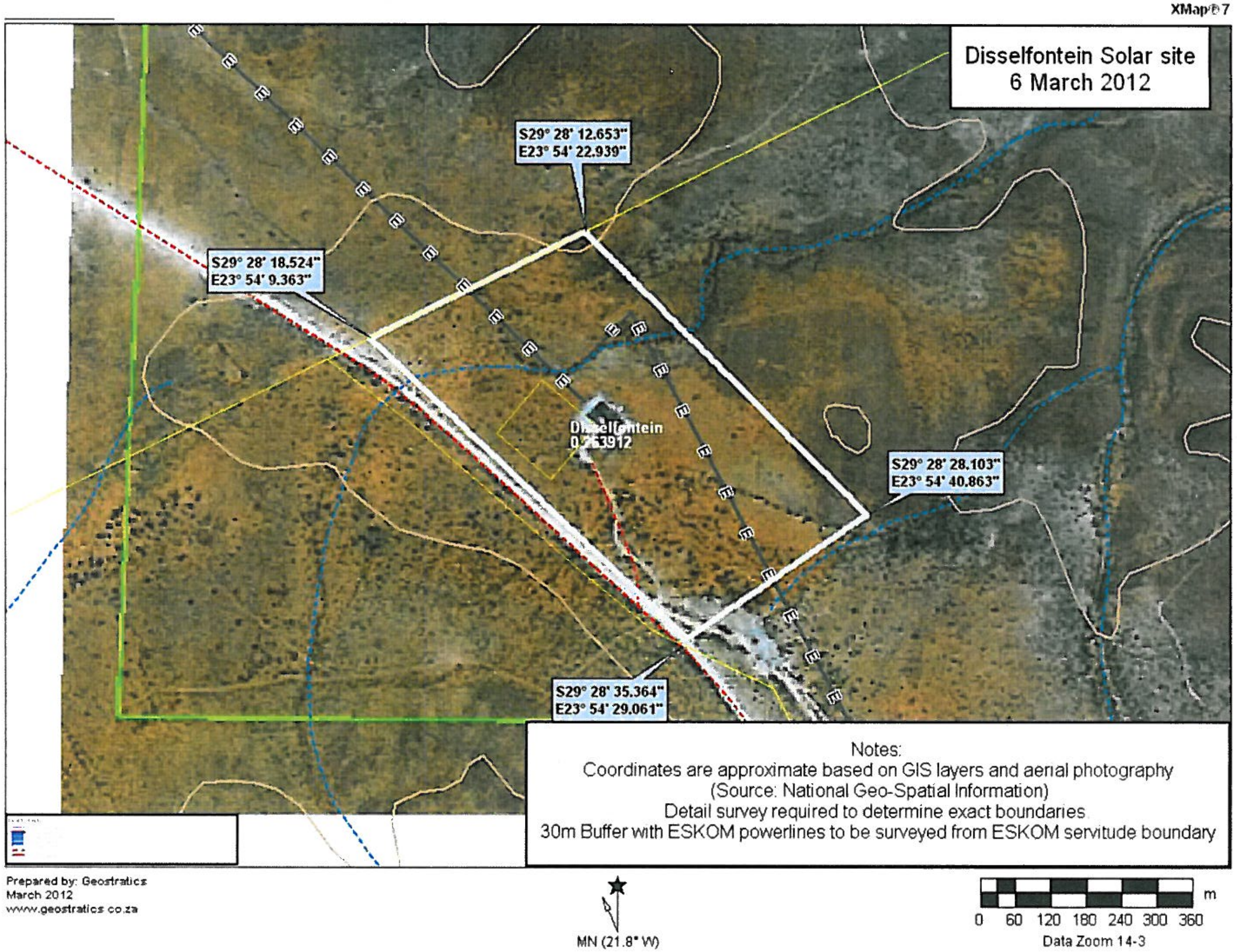

Fig. 13. Satellite image showing the study area for the Disselfontein Keren Solar Plant situated on the Remainder of Farm 77, Hopetown, close to the west bank of the Orange River and 23.5 km NW of Hopetown, Northern Cape (Image prepared by Geostratics 2012).

8. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

Appendix: GPS LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 60CSx instrument. The datum used is WGS 84.

Loc. No.	South	East	Comments
493	S29 28 31.9	E23 54 27.5	Kalahari sands, SW corner of study area
494	S29 28 34.0	E23 54 33.5	Quarry into Dwyka Group at southern edge of study area; calcretes, alluvial gravels
495	S29 28 25.9	E23 54 37.0	Bouldery outcrop area of Allanridge Fm lavas
496	S29 28 14.3	E23 54 30.9	Stream bed incised into Allanridge Fm
497	S29 28 19.8	E23 54 27.6	Polymict surface gravels in flat area to NE of substation
498	S29 28 25.7	E23 54 30.8	Shallow stream gully exposure of boulder calcretes beneath Kalahari sands

APPENDIX D3C VISUAL

DISSELFONTEIN, PORTION OF PORTION 8 FARM77: SOLAR ENERGY FACILITY

VISUAL ASSESSMENT

For consideration in the Basic Assessment
For
EnviroAfrica
PO Box 5367
Helderberg
7135
info@enviroafrica.co.za

Final Report
11 May 2012

Compiled by:
S.C. Lategan

GeoStratics

PO Box 1082
Strand
7139

Report history:

Version	Date	Amendments
Draft Report	26 March 2012	
Final Report	11 May 2012	

CONTENT

Tables:

Figures:

Relevant Qualifications & Experience of the Author
Ms Sarien Lategan holds a Honours Degree in Geography as well as a Masters Degree in Town and Regional Planning from the University of Stellenbosch. She has 7 years experience as Town planner at a local government, 3 years with South African national Parks as planner and project manager of various GEF and World Bank managed, tourist facilities in the Table Mountain National Park and since 2004 as private practitioner involved in inter alia Site Analysis and Visual Impact assessments for various types of developments ranging from housing, tourism to infrastructure developments.

Ms Lategan is registered as a professional Town and Regional Planner as well as Environmental Assessment Practitioner.

Declaration of Independence

I, Sarah C. Lategan, fully authorized by Geostratics CC, declare that I am an independent consultant to EnviroAfrica and neither myself nor Geostratics, has any business, financial, personal or other interest in the proposed project or application in respect of which I was appointed, other than fair remuneration for work performed in connection with the application. There are furthermore no circumstances which compromise my objectivity in executing the task appointed for.

SC Lategan

EXECUTIVE SUMMARY

Sarien Lategan of Geostratics was appointed to undertake the visual impact assessment of a maximum 10Megawatt solar facility, as input to the Basic Assessment in terms of the national Environmental management Act, 1998 (Act no. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010 by undertaken EnviroAfrica. The development of the solar farm is proposed by Keren Energy (Pty) Ltd. The site on which the facility is planned comprises a portion of Farm 8/77, Disselfontein in the Hopetown district.

The site is situated on a secondary gravel road approximately 25km northwest of Hopetown, south of the Orangeriver.

The aim of the assessment is to identify view receptors and assess the impact of the development on these receptors. In this regard the larger site was screened and based on this findings as well as inputs by other specialists, a most suitable area of 20ha was identified on which the final assessment focus.

At the time of assessment a final decision has not yet been taken on the exact technology or mix of technology to be used in the development. In this regard the worst case scenario has been followed by assessing the technology most probably going to have the most visual impact in terms of size of structures. Should a different technology thus been decided on which involve smaller units, the visual impacts will certainly be less than what is assessed in this report. For the purposes of this study thus, tracking CPV units of dimensions 15,64m in height and 17m wide has been assessed.

The assessment established that the receiving environment comprise an area dominated by low intensity agriculture, irrigation farming and game farming. The site is in close proximity to an ESKOM substation and HV power lines. The development will change the character of the area but the assessment establishes that due to the scale and absorption capacity of the environment, the change is within acceptable levels.

The only sensitive receptor identified is the road. The assessment established that the visual significance is medium and within acceptable levels.

The overall conclusion is that the visual impact is within acceptable levels and could thus be recommended.

1 BACKGROUND

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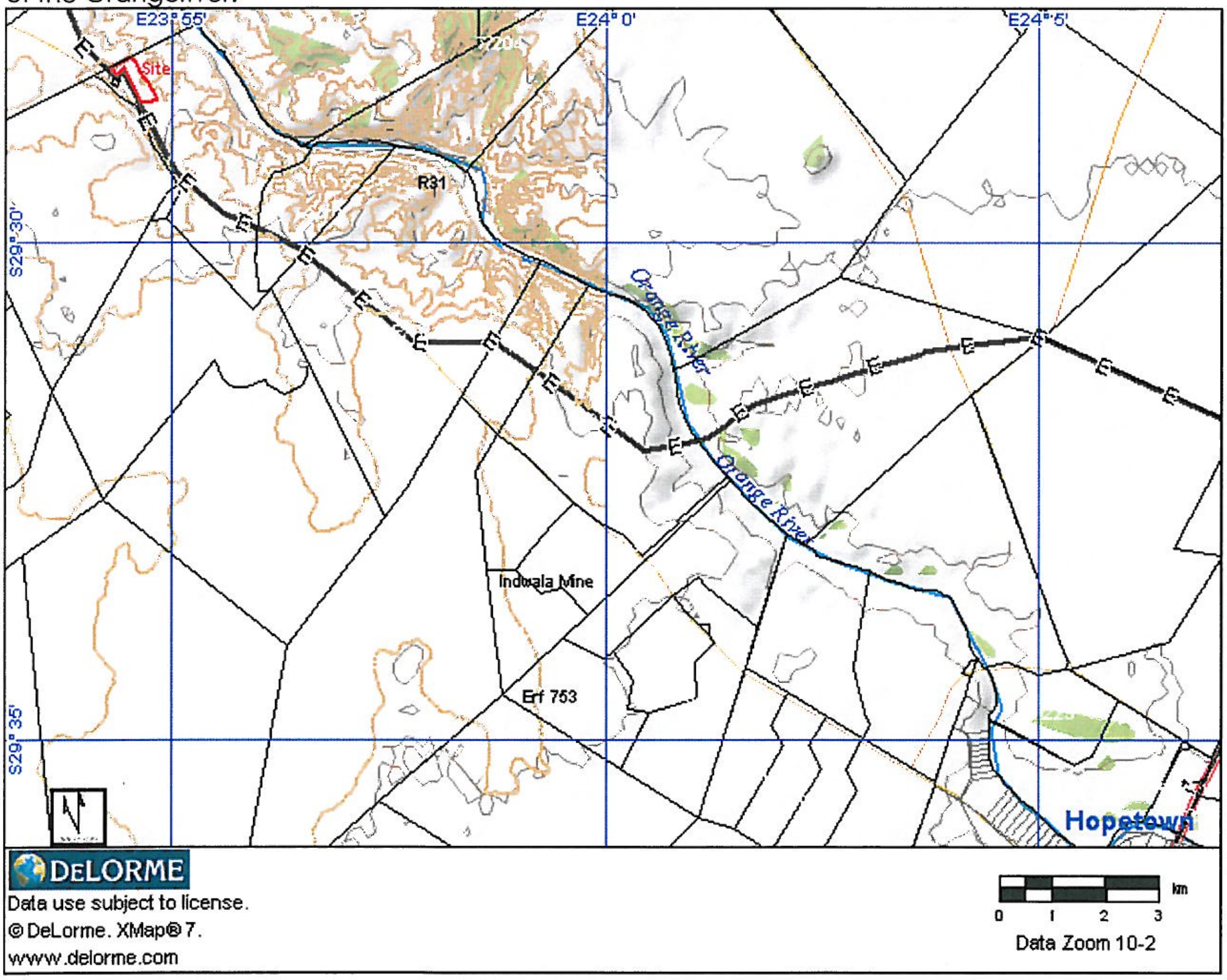

Figure 1: Locality

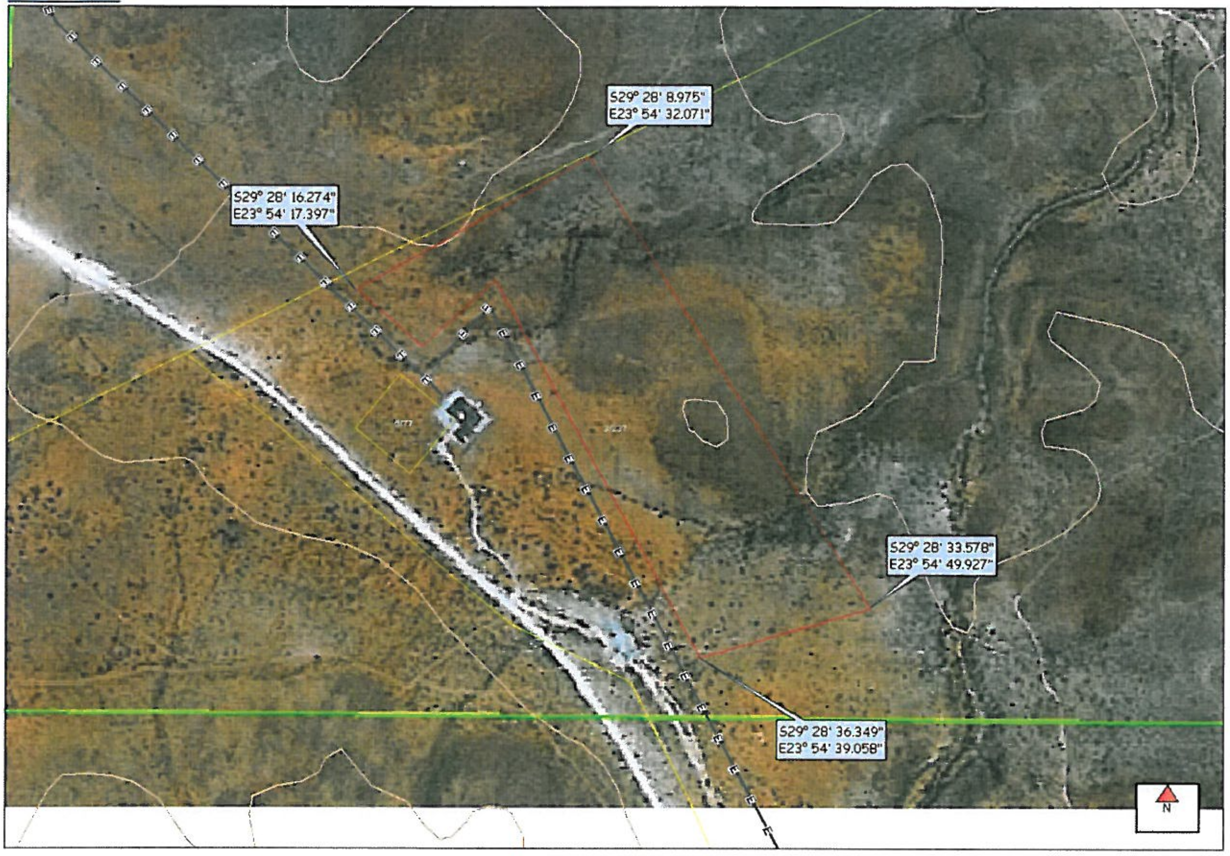

Figure 2: Site boundary

2 TERMS OF REFERENCE

The applicant intends the development of a solar farm on a portion of Farm 8/77, Disselfontein, Hopetown district. The site gain access off the R369 between Hopetown and Douglas, approximately 20km from Hopetown.

The objective of the Visual Impact assessment is to determine the significance of any visual impact. This assessment will indicate whether from a visual perspective the development constitute and acceptable level of change and if so what potential mitigation measures can reduce any visual impact as to limit

To determine the potential extent of the VIA required the following broad criteria are considered.

Areas with protection status, e.g. nature reserves	None
Areas with proclaimed heritage sites or scenic routes	None.
Areas with intact wilderness qualities, or pristine ecosystems	Natural areas, low intensity agriculture and game farming.
Areas with intact or outstanding rural or townscape qualities	None
Areas with a recognized special character or sense of place	None

Areas with sites of cultural or religious significance	None
Areas of important tourism or recreation value	The site is in a region where such elements exists and are important in the Green Kalahari tourist route, although the specific route, namely R31 has not been identified as a scenic drive or tourist route.
Areas with important vistas or scenic corridors	To assess.
Areas with visually prominent ridgelines or skylines.	None

Table 1: Requirements for visual assessment

High intensity type projects including large-scale infrastructure	yes
A change in land use from the prevailing use	Infill and expansion of property currently used for utility/infrastructure (ESKOM substation and HV power lines)
A use that is in conflict with an adopted plan or vision for the area	No
A significant change to the fabric and character of the area	No
A significant change to the townscape or streetscape	No
Possible visual intrusion in the landscape	Potentially
Obstruction of views of others in the area	Potentially

Table 2: Nature of intended development

From the above it is clear that the receiving environment holds certain visual elements which may be impacted upon by development of the site.

It is thus clear that the potential exist that development of the site may have a visual impact. In order to assist authorities thus to make an informed decision, the input of a specialist is required to assist in the project design and assess the visual impact of the preferred project proposal.

The term visual and aesthetic is defined to cover the broad range of visual, scenic, cultural, and spiritual aspects of the landscape. The terms of reference for the specialist are to:

- Provide the visual context of the site with regard to the broader landscape context and site specific characteristics.
- Provide input in compiling layout alternatives.
- To describe the affected environment and set the visual baseline for assessment
- Identify the legal, policy and planning context
- Identifying visual receptors
- Predicting and assessing impacts
- Recommending management and monitoring actions

3 Methodology and principles

3.1 Methodology

Table 4: Summary of methodology

Task undertaken	Purpose	Resources used
A screening of the site and environment	To obtain an understanding of the site and area characteristics and potential visual elements	Photographs Site visits
Identify visual receptors	To assess visual impact from specific view points	Photographs, profiles
Contextualize the site within the visual resources	To present an easy to understand context of the site within the visual resource baseline	Specialist: S Lategan Graphic presentation Superimposed photo's Model in case of high significance
Propose possible mitigation measures	To present practical guidelines to reduce any potential negative impacts.	Specialist: S. Lategan

Throughout the evaluation the following fundamental criteria applied:

- Awareness that "visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place.
- Consideration of both the natural and cultural (urban) landscape, and their inter-connectivity.
- The identification of all scenic resources, protected areas and sites of special interest, as well as their relative importance in the region.
- Understanding of the landscape processes, including geological, vegetation and settlements patterns which give the landscape its particular character or scenic attributes.
- The inclusion of both quantitative criteria, such as visibility and qualitative criteria, such as aesthetic value or sense of place.
- The incorporation of visual input as an integral part of the project planning and design process, so that the findings and recommended mitigation measures can inform the final design and quality of the project.
- To test the value of visual/aesthetic resources through public involvement.

3.1.1 Principles

The following principles to apply throughout the project:

- The need to maintain the integrity of the landscape within a changing land use process
- To preserve the special character or 'sense of place' of the area
- To minimize visual intrusion or obstruction of views
- To recognize the regional or local idiom of the landscape.

3.1.2 Fatal flaw statement

A potential fatal flaw is defined as an impact that could have a "no-go" implication for the project. A "no-go" situation could arise if the proposed project were to lead to (Oberholzer, 2005):

1. Non-compliance with Acts, Ordinance, By-laws and adopted policies relating to visual pollution, scenic routes, special areas or proclaimed heritage sites.
2. Non-compliance with conditions of existing Records of Decision.
3. Impacts that may be evaluated to be of high significance and that are considered by the majority of stakeholders and decision-makers to be unacceptable.

The screening of the site and initial project intentions did not reveal any of the above issues which may result in a fatal flaw.

3.1.3 Gaps, limitations and assumptions

The assessment has to be read with the following in mind:

1. No information is available on the alignment of transmission lines linking the solar facility with the ESKOM substation. Due to the fact that the site is adjacent the substation it is assumed that no off-site transmission lines will be required.

2. Access is obtained via existing roads and no road upgrades or new roads will be constructed.

3.1.4 Assessment explained

The assessment of visual impact is done on two levels namely the absorption rate of the receiving environment and the individual view receptors. The absorption rate of the receiving environment is determined by various elements e.g. topography, land use etc and the assessment will focus on the acceptable level of change of the area.
Visual receptors are assessed individually based on the sensitivity of the receptor, exposure to the development and intrusion rate.
The following framework is used in order to assess view receptors:

Criteria	High	Moderate	Low
Exposure	Dominant, clearly visible	Recognizable to the viewer	Not particularly noticeable to the viewer
Sensitivity	Residential, nature reserves, scenic routes	Sporting, recreational, places of work	Industrial, mining, degraded areas
Intrusion/Obstructive	Noticeable change, discordant with surroundings	Partially fits but clearly visible	Minimal change or blends with surroundings

A sensitive receptor with a low exposure and/or low intrusion rate can be regarded as a low significance rating. A receptor of low sensitivity but with high exposure can be of high significance if the intrusion rate is also high but is reduced if the intrusion rate is medium or low.
The overall significance therefore depends not only on the sensitivity of the receptor but also on the exposure and intrusion rate and thus a combination of the criteria.

3.2 Legal Framework, Guidelines and policies

3.2.1 National Environmental Management Act, 107, 1998 and relevant Guidelines:

An assessment in terms of any activity that required an EIA or Basic Assessment may be subjected to a specialist visual assessment in order to determine the significance of the potential impacts to result from a proposed activity.

The National Dept has subsequently determined that all applications for solar farms are subject to a visual impact assessment.

3.2.2 Northern Cape PSDF

The NCPSDF identified various use zones.
The PSDF provides guidance to ensure that

- development is of a quality that promotes environmental integrity.
- based upon the principles of 'critical regionalism" which promotes a return to the development of high-quality settlements.
- remised upon "The Big Five" principles that guide the planning, design and management of development namely sense of place, sense of history, sense of nature, sense of craft and sense of limits.

3.2.3 Green Kalahari tourism

The Green Kalahari tourist plan is an initiative to promote tourism in the region. The protection of cultural and heritage resources as well as the active involvement and empowerment of local communities through tourism is a core theme through the tourism plan.

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4 DEVELOPMENT PROPOSAL

4.1 General Description

Construction of Solar energy production facility ("Solar Farm") with a maximum capacity of 10Megawatt, consisting of approximately 140 tracking CPV units, on approximately 20ha. The exact technology to be used has not been determined and this assessment is based on the following typical parameters. Units are typically positioned in rows with access roads between every second row. Unit spacing typically varies between 43x37 and 33x30m.

Figure 3: Typical Solar Farm layout

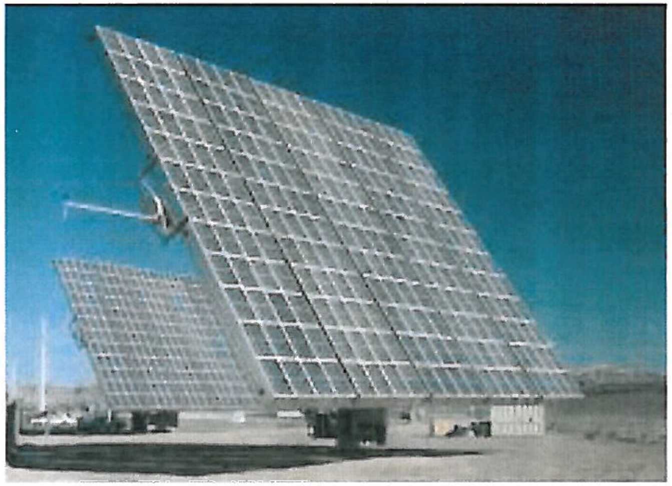


Figure 4: Typical CPV Unit

The Solar Farm includes supportive infrastructure which consists of 2 -4 concrete transformer pads approximately 20x15m respectively, a fenced construction staging area, maintenance shed and a switch panel for connection to the grid and transmission lines from the transformers to the closest ESKOM substation.

4.2 Project Elements
4.2.1 Extent and layout

The Solar farm will occupy approximately 20ha. The nature of the tracking CPV units are such that the property has to be leveled to less than 1:5 gradient in order to prevent the units to touch the ground when turning on the pedestal. CPV units are positioned in a grid with the active panel side facing north. The units will rotate from east (morning) to west (afternoon). Back of units facing south. Units are position in rows of two with access roads in between.

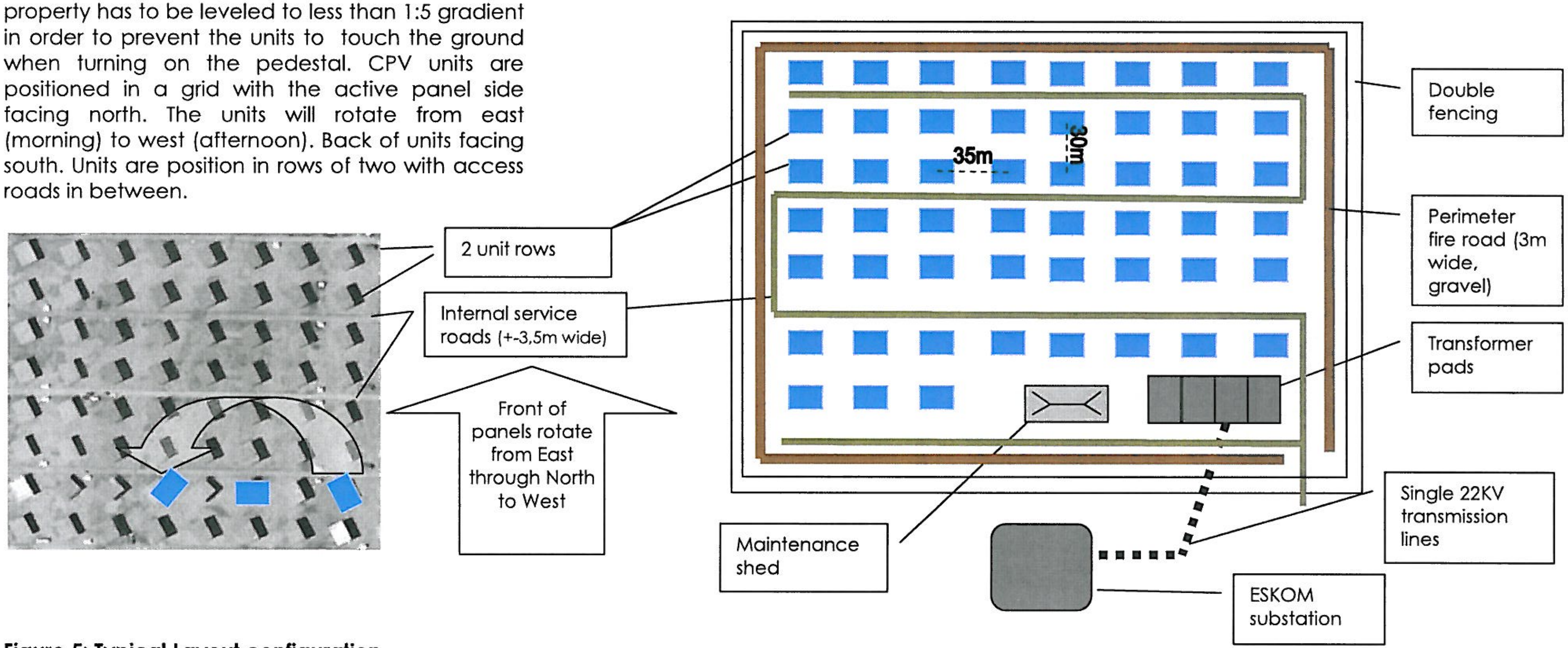


Figure 5: Typical Layout configuration

4.2.2 Tracking CPV Units

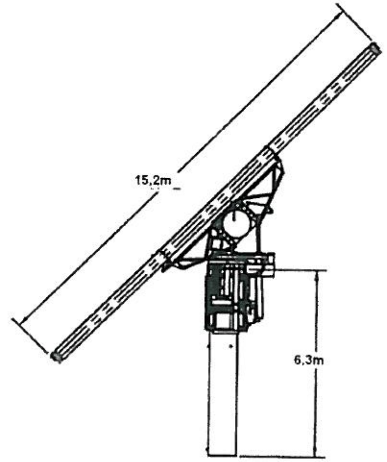
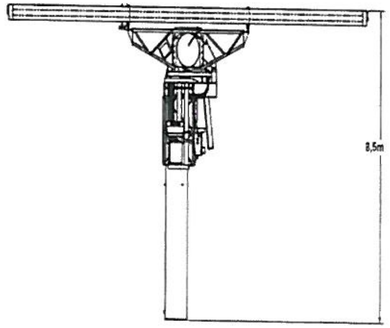


Figure 7: Typical Operational position



In stow: >28 mph. > 10 sec. Out of stow : <26 mph. >300 sec.
Figure 6: Storm Stow position

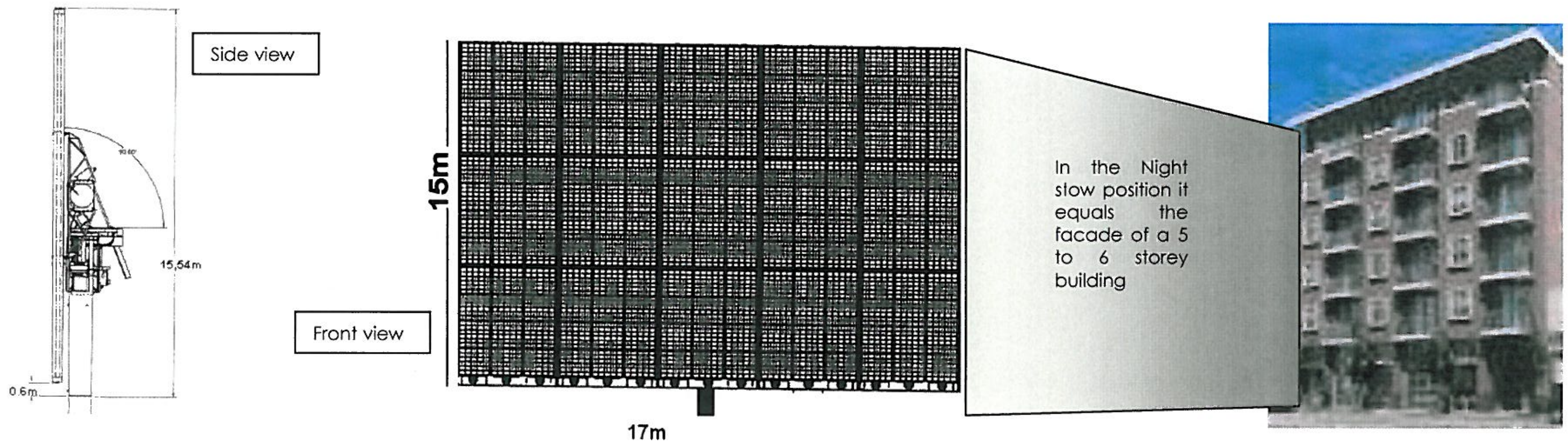


Figure 8: Night stow position

4.2.3 Project perimeter

Double fencing with inner fence consisting of galvanized palisade fence and outer an electrified fence of 2,4m in height.

Figure 9: Typical electrical fence

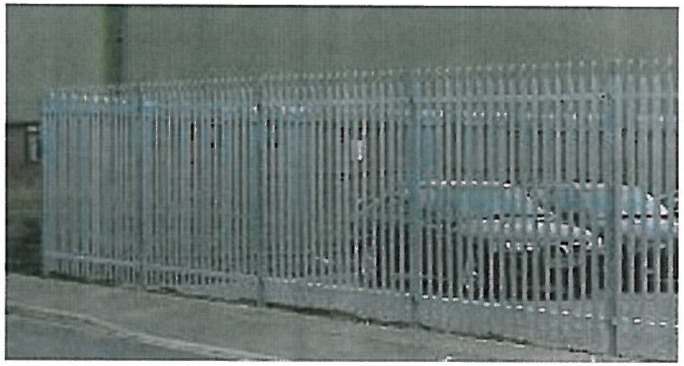


Figure 10: Typical galvanized palisade fence

4.2.4 Supportive Infrastructure

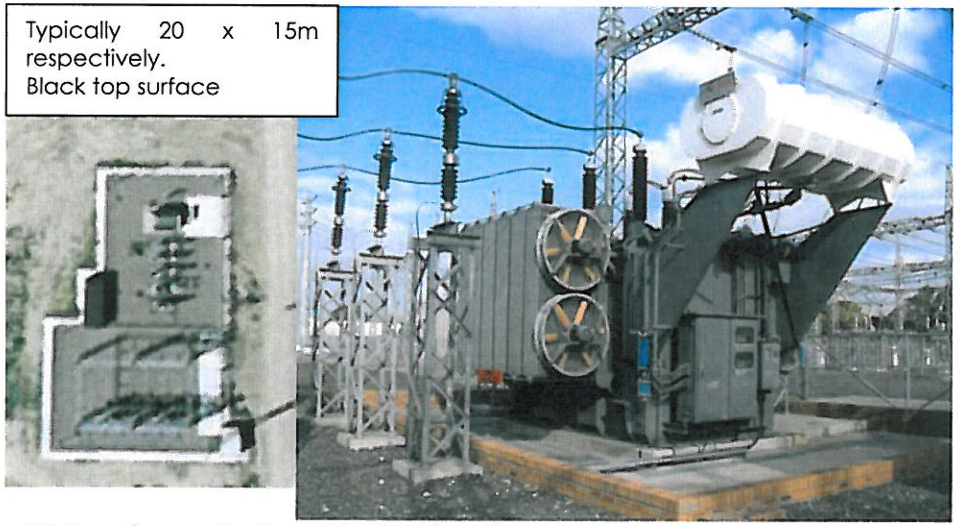


Figure 12: Transformer Pads and typical transformer

Single 22KV Power lines will feed from the transformers to the ESKOM

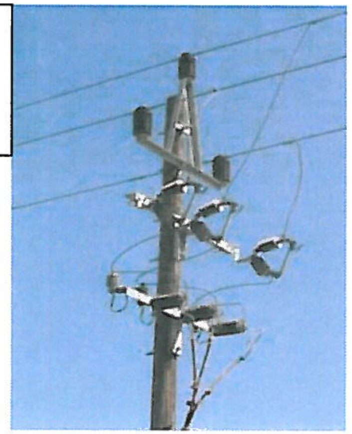


Figure 11: Typical 22KV single Power line

4.2.5 Operational elements

Depending on the exact technology the operational activities can vary. Tor the typical units described above, teams will access the site and physically clean panels. This is done either by rope access or the use of "cherry pickers". In areas of high dust conditions, cleaning can be more regular.

4.3 Construction elements

For the construction of the typical units describe above, large earth moving equipment will be used as well as high lift equipment and cranes. Large transport trucks for delivery will enter the site during construction. For technology that uses smaller units or static units the scale of equipment required for construction will be less.
Construction process entails:

- clearing and leveling of the site,
- construction of pedestals which involve concrete bases and
- fitting of panels
- construction of internal and access roads
- Fencing and security infrastructure
- Construction of support facilities such as maintenance sheds, etc
- Construction of transmission lines

5 RECEIVING VISUAL ENVIRONMENT

5.1 Description

Understanding the potential impact of a proposed development, an understanding of the receiving environment is important. In this regard the main elements of the receiving environment relates to the character of the current surrounding land use and the absorption capacity of the area. The character of the area entails the sense of place created by the current land use and the scale and type of infrastructure or physical elements within the immediate area. The absorption capacity relate to the density of physical elements and topographical variations of the landscape, which will determine the catchment area. The human eye will observe the horizon on a perfectly flat surface at a distance of 30km. This is however significantly reduced by landscape elements which obstruct the view.

5.1.1 Catchment area

The site is situated outside the river corridor in the immediate hinterland of the valley. Due to the topographical features consisting of low hills, the catchment area is restricted to approximately 5km in almost all directions. Limited viewpoints will be beyond this catchment area.

5.1.2 Sense of Place:

The site is situated in a rural to natural landscape and although low intensity farming occurs and electrical infrastructure exists, the overall sense of place display a natural character. The traveler on is between towns and will thus have a lower capacity to accept urban infrastructure than within a town. The region is however known for irrigation farming and intermittent observation of such activities again increases the traveler's capacity slightly. The presence of infrastructure is thus not totally foreign to the area, as long as it does not create a high level of intrusion.

5.2 Findings

The proposed site is situated in the rural area adjacent to the Orangeriver corridor. The Orangeriver corridor represent a production landscape, which in the immediate surrounds of the site has a lower level of irrigation farming and more extensive farming due to the topography. The proposed solar farm is however on the site of an existing ESKOM substation with HV power lines. The area displays a rural character with low intensity farming, game farming and natural areas.

The area is characterized by a flowing topography of low rises just outside the valley corridor. More hills and ridges occur closer to the river. The plain area however display such a level of gradient that present a fairly high level of absorption and view is on average restricted to the immediate environment and seldom more than 5km. The human eye can observe the horizon on a perfectly flat surface up to 30km. The Disselfontein area however displays sufficient gradient variations to restrict this view significantly, mostly below 2km.

Statement 1: The property on which the development is proposed, is currently used for substation and HV Power lines but the surrounding area has a rural character. The proposed solar farm will change the character of the immediate surrounds.

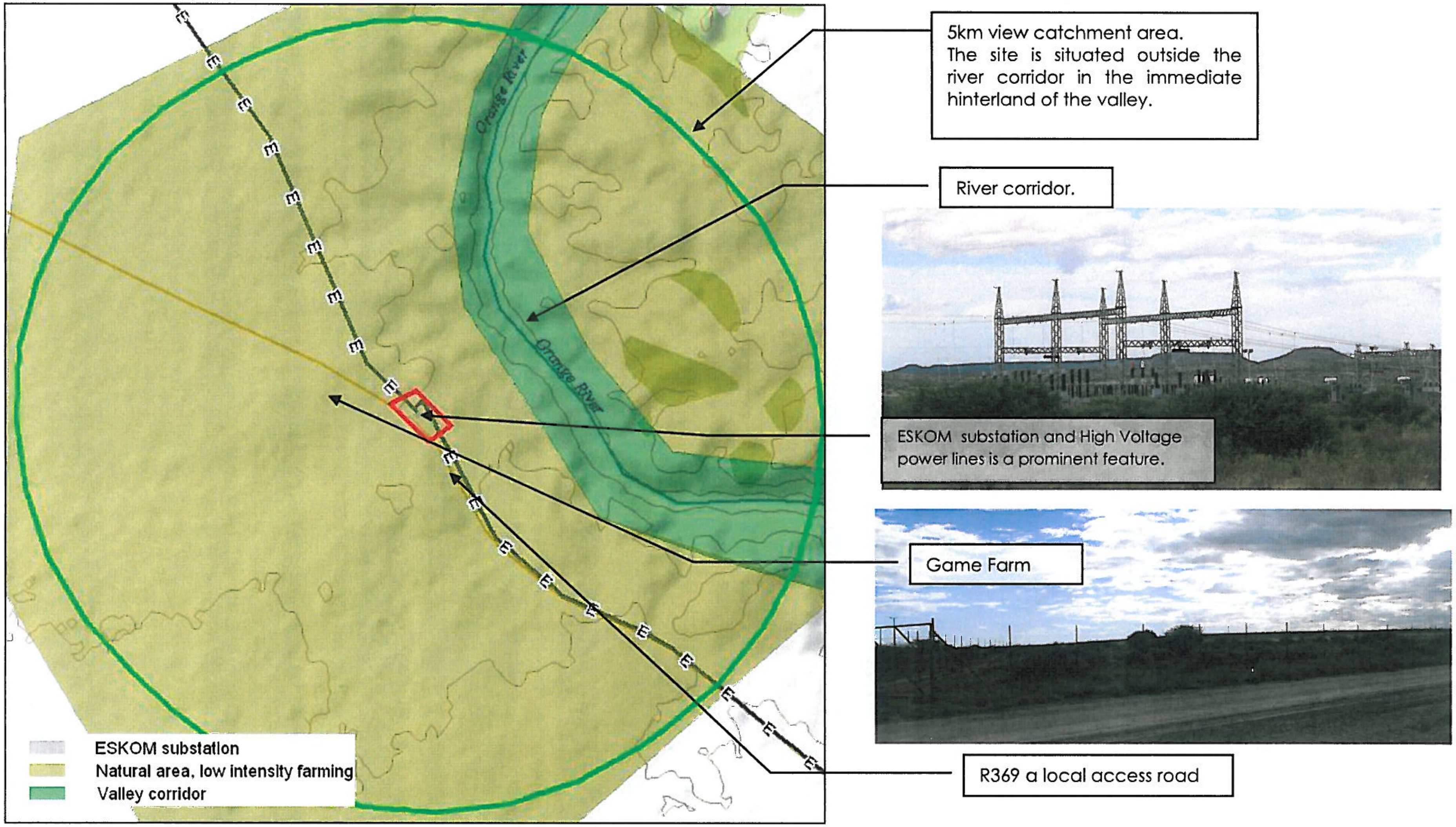


Figure 13: View catchment and site elements

6 VISUAL RECEPTORS

Visual receptors are those positions from where the development site is potentially visible. Based on the character of the locality of the receptor its sensitivity can be rated. Generally residential areas and tourism related destinations and routes are sensitive to visual intrusions as they relate to the well-being of residents and the tourism quality of the area.

6.1 Potential Receptors

The only identified receptor is the secondary road linking Hopetown and Douglas. (Figure 14)

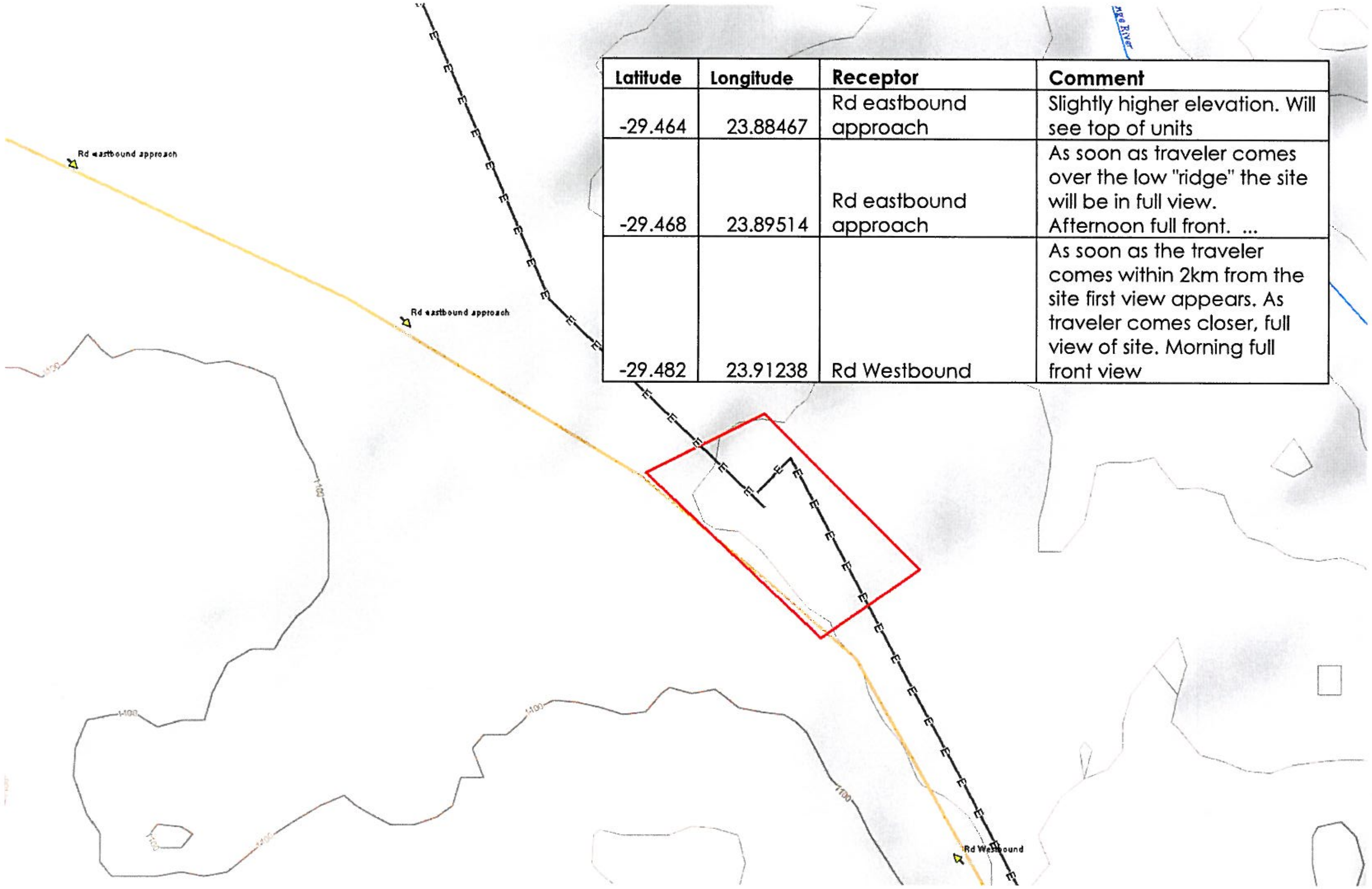
6.2 Assessment of Receptors

1. Eastbound (Figure 15): As the traveller approach from the west the site is out of view until crossing a low ridge to the east, from where the landscape terraced down to the site and exposure increases.
   When the traveller passes the site, the units are dominant. The units are however facing north and thus the back of units are visible and no glare is expected off the back of the panels.

   Visual significance is medium

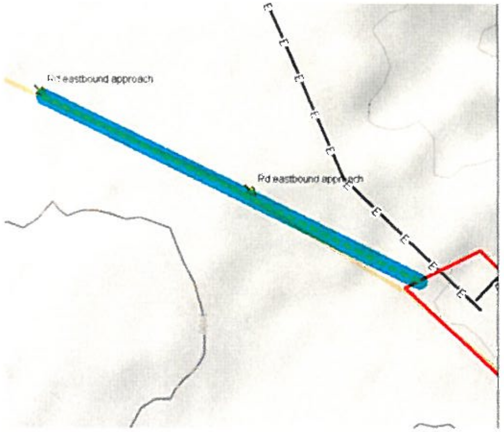
2. Westbound (Figure 16): As the traveller approach from the east, the site is out of view until approximately 800m from the site.
   When the traveller passes the site, the units are dominant. The units are however facing north and thus the back of units are visible and no glare is expected off the back of the panels. In the morning the panels will be facing east, but the orientation of the traveller is such that the panels will not face the approaching traveller

   Visual significance is medium

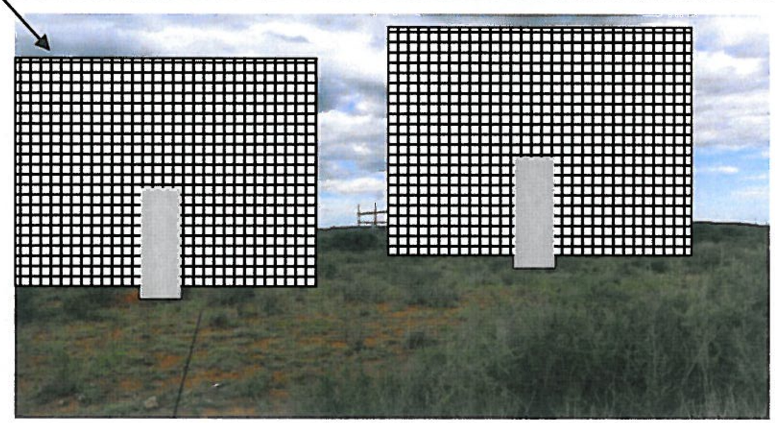


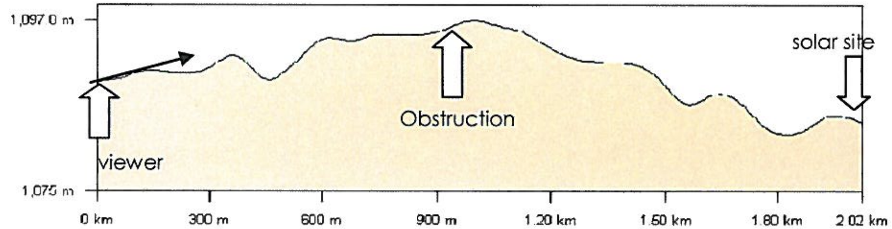
Latitude	Longitude	Receptor	Comment
-29.464	23.88467	Rd eastbound approach	Slightly higher elevation. Will see top of units
-29.468	23.89514	Rd eastbound approach	As soon as traveler comes over the low "ridge" the site will be in full view. Afternoon full front. ...
-29.482	23.91238	Rd Westbound	As soon as the traveler comes within 2km from the site first view appears. As traveler comes closer, full view of site. Morning full front view

Figure 14: Visual Receptors



As the traveller approach from the west the site is out of view until crossing a low ridge to the east, from where the landscape terraced down to the site and exposure increases.
When the traveller passes the site, the units are dominant. The units are however facing north and thus the back of units are visible and no glare is expected off the back of the panels.





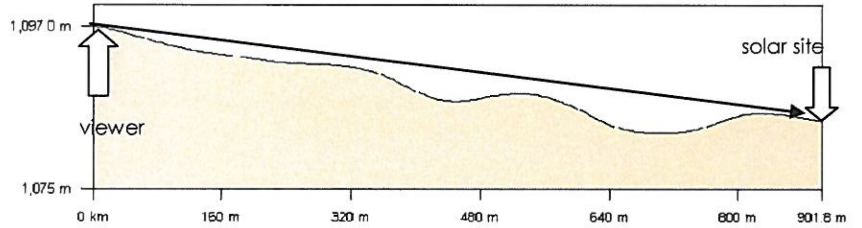
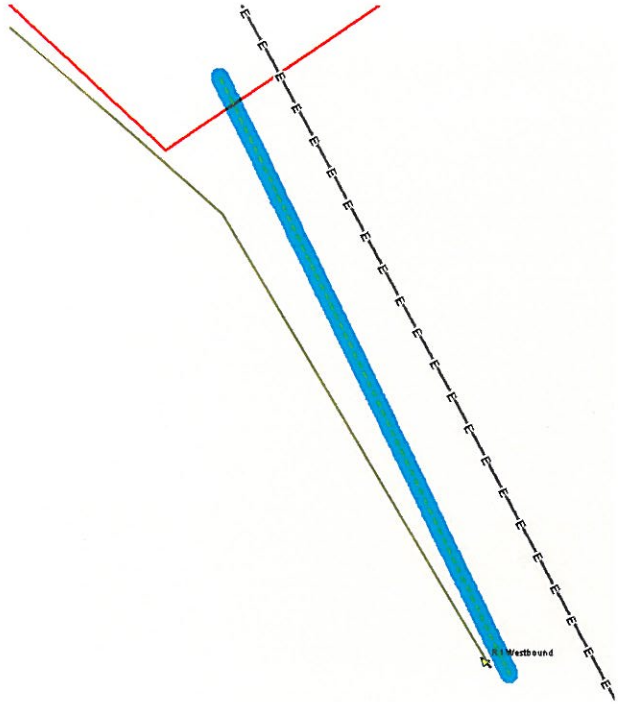
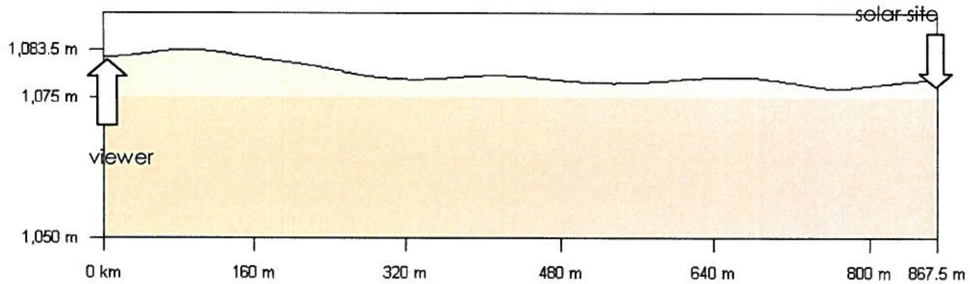


Figure 15: Road Eastbound as receptor

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity	residential, nature reserves, scenic routes	sporting, recreational, places of work	industrial, mining, degraded areas, local access road
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 3: Road Eastbound as receptor assessed





As the traveller approach from the east, the site is out of view until approximately 800m from the site.
When the traveller passes the site, the units are dominant. The units are however facing north and thus the back of units are visible and no glare is expected off the back of the panels. In the morning the panels will be facing east, but the orientation of the traveller is such that the panels will not face the approaching traveller

Figure 16: Road Westbound as receptor

Criteria	High	Moderate	Low
Exposure	dominant, clearly visible	recognizable to the viewer	not particularly noticeable to the viewer
Sensitivity	residential, nature reserves, scenic routes	sporting, recreational, places of work	industrial, mining, degraded areas
Intrusion/Obstructive	noticeable change, discordant with surroundings	Partially fits but clearly visible	minimal change or blends with surroundings

Table 4: Road Westbound receptor assessed

Table 5: Summary of Visual Receptor assessment

Latitude	Longitude	Receptor	Comment	Exposure	Sensitivity	Intrusion/Obstructive	Finding
-29.464	23.88467	Rd eastbound approach distant	Slightly higher elevation. Will see top of units.	The low flowing hills screen view from a distance. Only once traveler pass over last low hill does the site becomes visible Rating: Low	The R369 is a local gravel road giving access to local farmers. Rating: Low	The top of units may be visible but not obstructive. A side view of units which reduce extent of view. Rating: Moderate	Although the site will be in full view of the traveler the road is of low order and the CPV panels are in character with the substation and ESKOM power lines. The duration of view is short as the viewer travel at least at 80km/h along this route. The overall significance of the change of landscape is low.
-29.468	23.89514	Rd eastbound approach	As soon as traveler comes over the low "ridge" the site will be in full view. Afternoon full front. ...	The solar farm will be in full view of the traveler with no screening. Rating: High		The units will be in full view. The traveler passes at the back of the units and will at first only have a side view of the units. Only when pass directly next to units will the extent be increased. Does however fit with substation and HV power lines Rating: Moderate	
-29.482	23.91238	Rd Westbound	As soon as the traveler comes within 2km from the site first view appears. As traveler comes closer, full view of site. Morning full front view	The solar farm will be in full view of the traveler with no screening. Rating: High		The units will be in full view. The traveler passes at the back of the units but will at first have a full front view during the morning. Only when pass directly next to units will the extent be increased. Does however fit with substation and HV power lines. Rating: Moderate	

7 CONSTRUCTION

During construction, various large earth moving equipment and equipment will be transported to the site and work on the site. This will impact on the general experience of viewers. This impact is however temporary and not uncommon during construction of infrastructure. Communities have fairly high tolerance levels for such activities if it contributes to the infrastructure of the area.
Rating: Low

8 FINDINGS

The site is situated in an area with a rural character. The immediate are however do host an electrical substation and HV lines. The solar farm will thus change the character of the immediate environment. The view catchment is however small due to topographical variations. The landscape has a medium absorption rate which reduces the significance of land use change.

The R369 will be exposed to the site, but the impact is of short duration and linked to existing similar infrastructure namely the substation and HV lines. The short duration of view reduce the significance of impact.

As the CPV units are planned next to the substation, the transmission lines will be on-site and not add any additional off-site visual impact to the development

The facility has a high exposure when the viewer is within approximately 1km of the site. The duration of view is however short as the viewer travel passes the site. Although the proposal does have a high intrusion level in close proximity, the short duration reduce the overall visual impact and therefore not present an unacceptable level of change to the visual environment and therefore the development can be recommended.

9 MITIGATION MEASURES

The nature of the development is such that very little mitigation measures is possible. It can be considered to provide a soft screening along the road to create a buffer between the imposing CPV units and the traveler.