Appendix A

PALAEONTOLOGICAL DESKTOP STUDY

PALAEONTOLOGICAL DESKTOP STUDY:

Proposed Droogfontein Solar Power Project on the farm Droogfontein 62 near Kimberley, Northern Cape Province

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1. SUMMARY

The proposed Droogfontein solar energy project comprises a 50MW photovoltaic (PV) plant in Phase 1 followed by a 150MW concentrated solar power (CSP) plant in Phase 2. The development site on farm Droogfontein 62 is situated on the southern side of the Vaal River some 12-15km north of Kimberley in the Northern Cape Province. The study area is underlain at depth by ancient Precambrian lavas of the VentersdorpSupergroup (Allanridge Formation) of Late Archaean age (*c.* 2.7 billion years old) as well as by Early Permian mudrocks of the Ecca Group (Prince Albert Formation). Highly fossiliferous exposures of the last unit are known along the Vaal River at Douglas, *c*. 100km to the south-west. However, at Droogfontein the Prince Albert sediments are almost entirely mantled by several meters of aeolian sands of the Kalahari Group (Gordonia Formation) that are of low palaeontological sensitivity, as are also the associated calcretes. Potentially fossiliferous, fresh (unweathered) Prince Albert rocks are therefore unlikely to be intersected by the shallow excavations involved during construction of the power plant. Ancient alluvial gravels of the Windsorton Formation are mapped just to the west of the study area but not on Droogfontein itself. Fossiliferous younger gravels may well occur along the banks of the Vaal River here, but are unlikely to be directly affected by the proposed solar park development. The overall impact of the proposed development on local fossil heritage is considered to be *low* and specialist palaeontological mitigation for this project is not considered necessary.

Should substantial fossil remains be exposed during construction, however, such as well-preserved fossil fish, reptiles or petrified wood, the ECO should safeguard these, preferably *in situ*, and alert SAHRA as soon as possible so that appropriate action (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

2. INTRODUCTION & BRIEF

The company Mainstream Renewable Power South Africa (MRP) is proposing to construct a solar power plant on agricultural land on the farm Droogfontein 62. The site is situated on level ground on the southern banks of the Vaal River approximately 12 to 15km north of Kimberley and 15km east of Barkley West in the Northern Cape Province. The location of the proposed development is shown in the map Fig. 1 and the proposed layout in satellite image Fig. 2. Phase 1 of the solar power plant will comprise a 50MW photovoltaic (PV) plant in two small areas in the south-eastern part of the Droogefontein study area. Phase 2 of the development envisages a 150MW concentrated solar (CSP) plant spread over two larger areas in the southern and central part of Droogfontein. The study area is bordered on the south by a 275kV transmission line and is also traversed by a 132kV transmission line. The northern sectors of Droogfontein that border the Vaal River are currently used for agricultural purposes. These sectors, as well as several pans in the south that may be subject to seasonal flooding, are to be excluded from the solar power plant developments.

Components of the Phase 1 PV solar plant of relevance to the present study include:

- a photovoltaic (PV) panel array comprising *c*. 160 000 panels over an area of approximately 2km^2. Each array is 15m x 4m in area and supported by concrete or screw pile foundations.
- building infrastructure including an office and a warehouse.
- electrical infrastructure including buried or pole-mounted cables and a central substation (*c*. 90m x 120m) or new overhead powerline or poles or pylons to an existing power line.
- new or upgraded gravels roads for access to the site as well as an internal road network. Site roads will be 10m wide and there will be drainage trenches along their sides with silt traps at the outfall of the drainage trenches into existing watercourses.
- a solar resource monitoring station (100m^2).
- a temporary lay down area of *c*. 10 000m^2 adjacent to the site or access route.
- possible new borrow pits (to be separately permitted); existing borrow pits are to be used as far as possible. Borrow pits will be backfilled after construction of the PV plant.

Components of the Phase 2 CSP solar plant of relevance to the present study include:

- a solar field of parabolic trough mirrors covering an area of approximately 600 hectares. These will require foundations of no more than 1m depth.
- power block comprising solar steam generators, a steam turbine and a wet cooling tower.
- a 350mm diameter water pipeline from the municipal sewage treatment plant (pipeline route not yet determined)
- evaporation ponds (shallow) adjacent to the solar field.
- building infrastructure including offices, a control room, a fabrication building and warehouse.

- thermal storage tanks containing salt.
- a water treatment plant.
- electrical connections, including a new distribution substation (90m x 120m) close to existing power lines; a short new overhead powerline with pylons or poles may be required.
- upgrading of existing public roads, *plus* new gravel access road and internal site road network (roads 10m wide); existing farm roads will be used as far as possible.
- solar resource monitoring station.
- temporary lay down area of up to 10 000m^2 plus temporary contractors site offices (5000m^2 or less).
- possible new borrow pits, to be infilled after construction; existing borrow pits will be used as far as possible.

The proposed solar power plant overlies potentially fossiliferous sediments of the Ecca Group (Karoo Supergroup) and Kalahari Group. Fossils preserved within the bedrock or superficial deposits may be disturbed, damaged or destroyed during the construction phase of the proposed project. 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 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 Heritage Resources Act include, among others:

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

This desktop palaeontological study has accordingly been commissioned by PGS - Heritage & Grave Relocation Consultants.

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 May 2007.

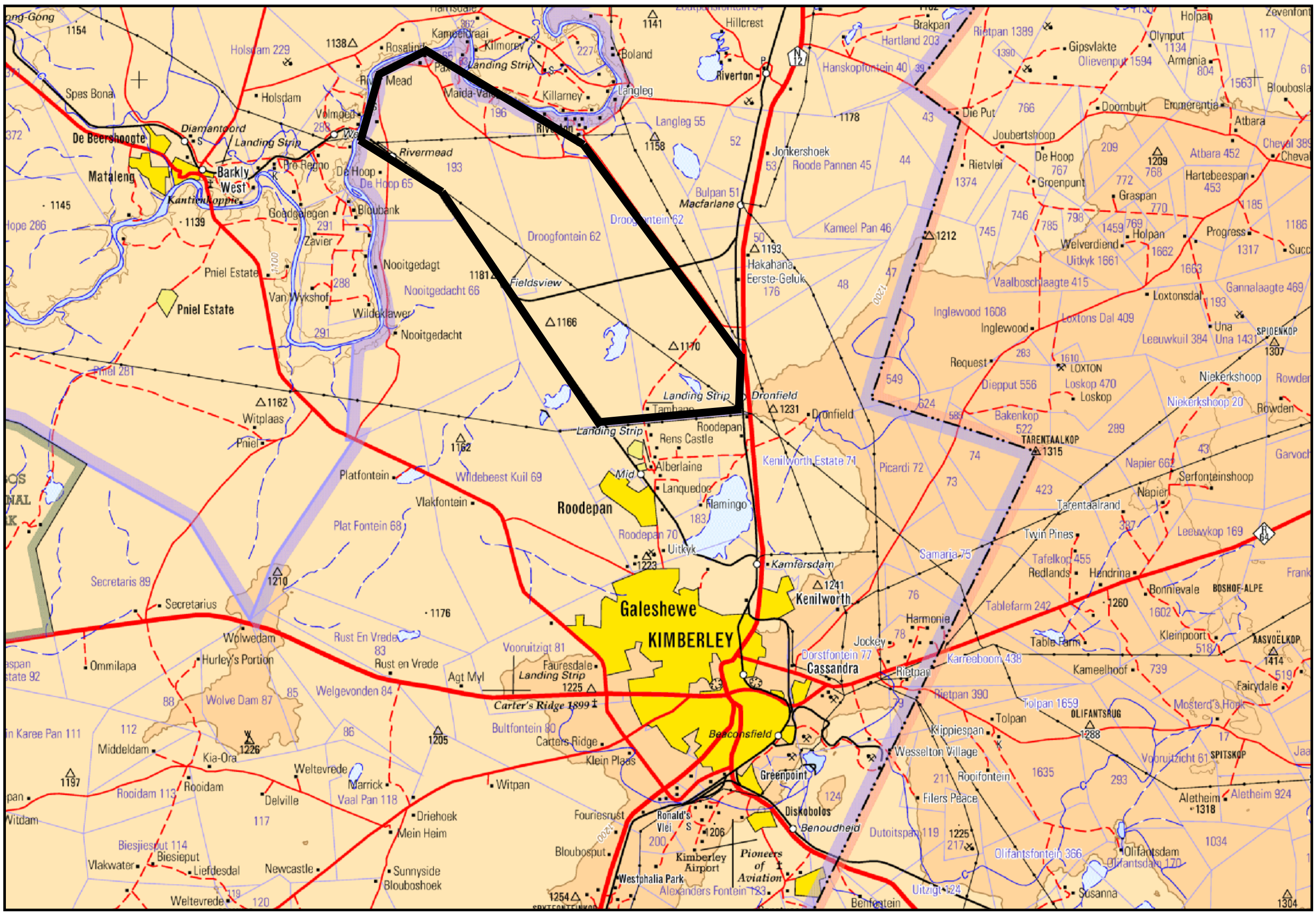

Fig. 1. Extract from 1: 250 000 topographical map 2824 Kimberley (Courtesy of the Chief Directorate of Surveys & Mapping, Mowbray) showing approximate location of the proposed Droogfontein Solar PV project *c*. 10-15 km north of Kimberley, Northern Cape Province (black polygon). See also satellite image in Fig. 2.

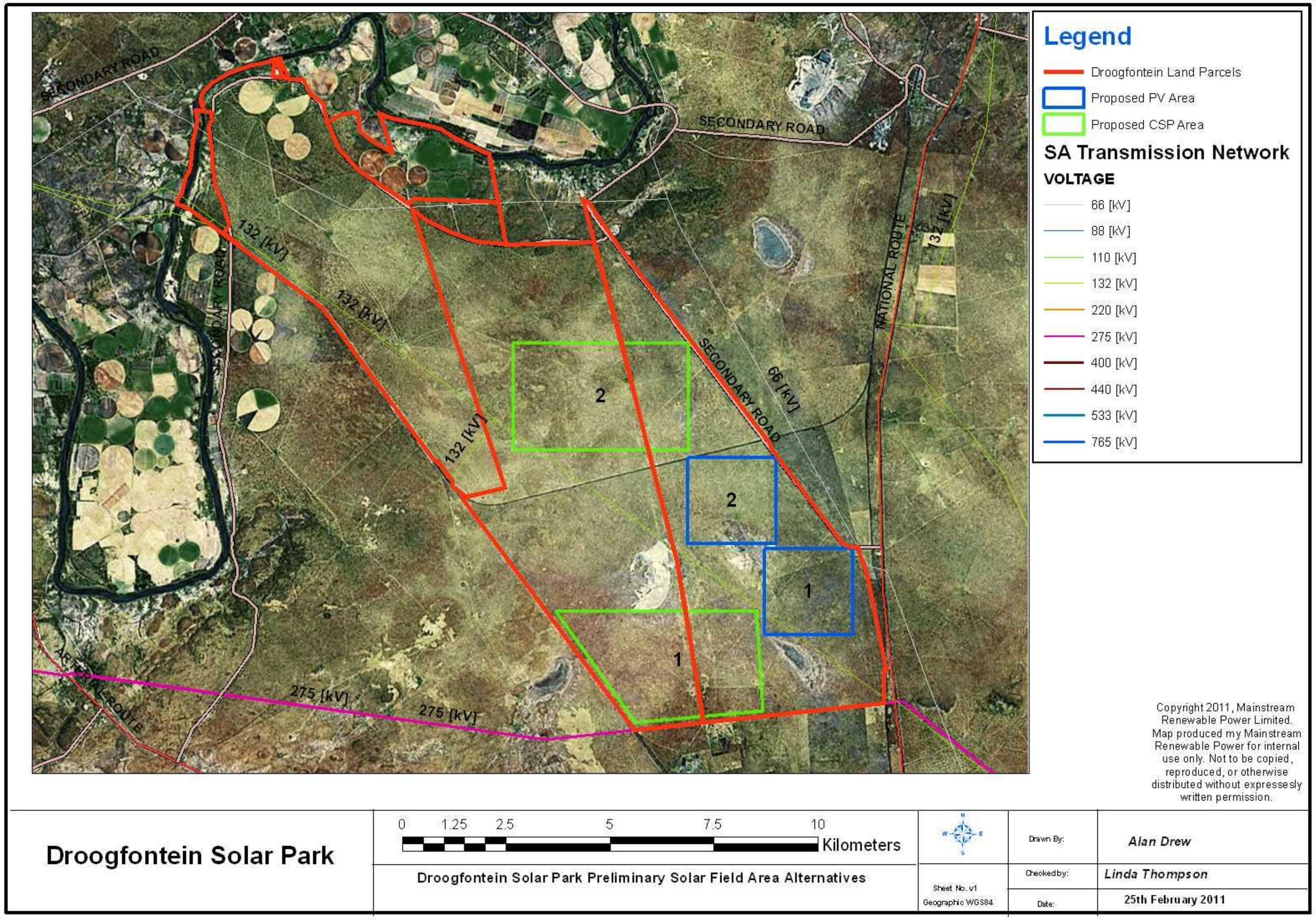

Fig. 2.Satellite image of the proposed Droogfontein Solar Park north of Kimberley (Image provided by Mainstream renewable Power, Engineering & Construction).

2.2. General approach used for palaeontological desktop studies

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-based 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, portentially 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

3. GEOLOGICAL BACKGROUND

The geology of the study area north of Kimberley is shown on the 1: 250 000 geology map 2824 Kimberley (Council for Geoscience, Pretoria; Fig. 4 herein). An explanation for the Kimberley geological map has been published by Bosch (1993).

The Droogfontein study area is occupied by flat-lying terrain (gradients less than 3°) at 1100-1200m amsl on the southern side of the Vaal River (Fig. 2). The central portion of the area features several small inliers of basement rocks mapped as the **Allanridge Formation** (**Ra**) of the **VenterdorpSupergroup**. 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). Since these ancient basement rocks are not known to be fossiliferous, however, they will not be considered further here. Conical stromatolites are recorded from the underlying Bothaville Formation.

Small inliers of laminated basinalmudrocks of the **Prince Albert Formation** (EccaGroup)(**Ppr**) are mapped in the northeastern and southern sectors of the study area. This unit of Early Permian (Asselian / Artinskian) age was previously known as "Upper DwykaShales" and reaches a thickness of 90m in the Kimberley area (Bosch 1993). Useful recent geological accounts of the Ecca Group are given by Johnson *et al.* (2006) and Johnson (2009). Key reviews of the Prince Albert Formation are given by Visser (1992) and Cole (2005). The Prince Albert Formation in the Kimberley - Britstown area consists predominantly of dark, well-laminated basinalmudrocks (shales, siltstones) that are sometimes carbonaceous or pyritic and typically contain a variety of diagenetic concretions enriched in iron and carbonate minerals (McLachlan & Anderson 1973, Visser *et al.* 1977-78, Zawada 1992, Bosch 1993). Some of these carbonate concretions are richly fossilferous (See Section 4.1 below). Much of the Ecca shale outcrop has been modified by surface calcretization (Zawada 1992). Palaeontologically important exposures in incised river banks near Douglas, to the west of Kimberley, are described by McLachlan and Anderson (1973). The Ecca beds here are mantled with a thin veneer (*c*. 3m) of intrusive dolerite, Quaternary calcrete and reddish Kalahari sands (= Gordonia Formation). They mainly comprise shales with a band of ferruginous carbonate as well as a 6m-thick zone of fossiliferous calcareous concretions that lies 9m above the base of the formation.

The great majority of the Droogfontein study site is mantled by superficial deposits of Quaternary to Recent age, especially Pleistocene aeolian (wind-blown) sands of the **Gordonia Formation** (**Kalahari Group**) (**Qs**). The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas & Shaw 1991, Haddon (2000) and Partridge *et al.* (2006). The Gordonia dune sands are considered to range in age from the Late Pliocene / Early Pleistocene to Recent, dated in part from enclosed Middle to Later Stone Age stone tools (Dingle *et al*., 1983, p. 291). Note that the recent extension of the Pliocene - Pleistocene boundary from 1.8Ma back to 2.588 Ma would place the Gordonia Formation almost entirely within the Pleistocene Epoch. At the latitude of the Kimberley study site (28° 30"S) Gordonia Formation sands less than 30m thick are likely to be the main or perhaps the only Kalahari sediments present (*cf* isopach map of the Kalahari Group, fig. 6 *in* Partridge *et al*., 2006). These unconsolidated sands *might* be locally underlain by thin surface gravels equivalent to the **Obobogorop Formation**, as well as by pebbly calcretes of Plio-Pleistocene age or younger (**Mokalanen Formation**; Fig. 5. Field photos of test pits in the geotechnical report for Droogfontein (Anon, Mainstream Renewable Power, 2011) show a thin topsoil underlain by pale to orange-brown Kalahari sands to depths of 2.3m or more over a large area of the site (Fig. 3). The sands are unconsolidated near-surface but below 2.5m depth may be secondarily cemented with whitish calcrete. Occasional bouldery and gravelly horizons were also encountered.

Fig. 3. Field photos from the geotechnical report for the Droogfontein development site showing deep orange-hued Kalahari sands (LHS) with pale calcrete at depths of c. 2.5m in some trial pits (Mainstream Renewable Power, 2011).

Relict patches of elevated Late Tertiary to Quaternary **alluvial gravels** ("High Level Gravels") are mapped along both the Vaal and Orange Rivers in the Windsorton – Kimberley – Douglas - Prieska area, where they have been associated with diamond mining (De Wit *et al*., 2000, their table 4.1 and fig. 4.1). These gravels are not mapped within the Droogfontein study area on geology sheet 2824 Kimberley. However, "Older Gravels" do occur on farm Nooigedacht 66 just to the west of

Droogfontein (Qa / DA in Fig. 4; Engelbrecht 1963, Bosch 1993 p. 37) and later occurrences (“Youngest Gravels” of Bosch 1993, p. 38) may be present along the banks of the Vaal River. These possible younger gravels will not be directly impacted by the proposed solar park development, however. In the Windsorton area to the north of Kimberley heavily calcretized “Older Gravels” have been grouped into the **Windsorton Formation** and are suspected to be Miocene-Pliocene in age (Partridge & Brink 1967, De Wit *et a*l., 2000, Partridge *et al.* 2006). The “Younger Gravels” (**Rietputs Formation**) of the Vaal River system, at lower elevations, are associated with Acheulian stone tools and are therefore considered to be Early to Middle Pleistocene (Cornelian) in age (Klein 1984, Table 2, Butzer*et al*., 1973, Partridge *et al*., 2006). Recent cosmogenic nuclide dating of coarse gravels and sands in the Rietputs Formation gave an age of *c*. 1.57 Ma (Gibbon *et al.,* 2009).

Small patches of **calcretes** (pedogeniclimestones) (Qc) are mapped along the eastern edge as well as in the south of the Droogfontein study area. The latter appear to be associated with Karoo sediments of the Prince Albert Formation but may also represent calcretized wind-blown sands blown southeastwards out from several small pans in this region (Bosch 1993). Extensive calcretes overlying the Karoo Supergroup and older basement rocks in the Douglas area to the WSW of Kimberley, forming a broad band either side of the Orange River, may be, at least in part, stratigraphically equivalent to the **Mokalanen Formation** of the Kalahari Group (Fig. 5). According to Zawada (1992) calcretes are especially well developed overlying the Ecca Group outcrop in the Koffiefontein sheet area to the east of Douglas. The commonest type in this region are the so-called Second Intermediate Calcretes that contain Middle Stone Age tools dated between *c*. 300 000 and 50 000 years, indicating a Pleistocene age (Note that Partridge *et al*., 2006, suggest an older, Late Pliocene, age for the Mokalanen Formation proper). Older calcretes are associated with calcified alluvial gravels (see below), and younger ones form hard pans adjacent to extant pans (Potgieter 1974, Partridge & Scott 2000). The thickness of these surface calcretes is not specified, but is unlikely to exceed a few meters in most areas.

While Early Jurassic (183 Ma) **Karoo dolerite intrusions** (Jd) are not mapped within the study area itself, the Ecca rocks here have probably been thermally and chemically modified by nearby intrusions. **Kimberlite pipes** and **fissures** dated to 77-120 Maare mapped in the study area where they intrude the VentersdorpSupergroup lavas (diamond symbols in Fig. 4; Bosch 1993 Table 8.1, Skinner &Truswell 2006). These Early Jurassic to Early Cretaceous igneous rocks do not contain fossils. However, where the associated crater-lake sediments are preserved beneath cover sands they sometimes prove to be highly fossiliferous, as seen in examples from Bushmanland (*e.g.* Scholtz 1985, Smith 1986a, 1986b, 1988, 1995).

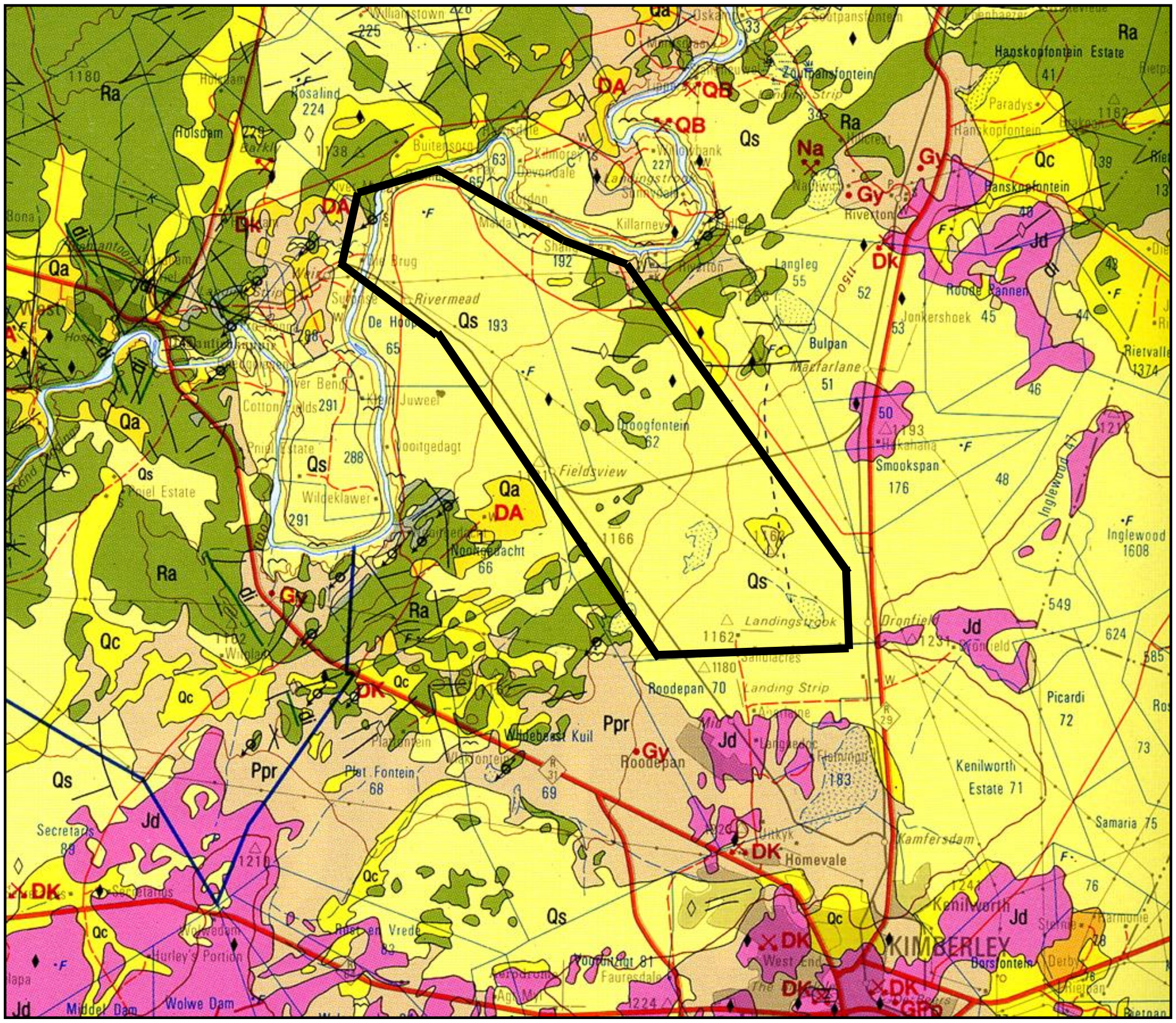

Fig. 4. Extract from the 1: 250 000 geological map 2824 Kimberley (Council for Geoscience, Pretoria) showing approximate location of proposed Droogfontein Solar Park (black polygon).

The main geological units represented in the study region include:

Ra (green) = Allanridge Formation (Platberg Group, VentersdorpSupergroup)
Ppr (buff) = Prince Albert Formation (Ecca Group)
Jd (pink) = Karoo Dolerite Suite

Qs (pale yellow) = aeolian dune sands (Gordonia Formation, Kalahari Group)
Qc (medium yellow) = surface calcrete, calcified pan dunes
Qa (dark yellow) = ancient alluvial gravels (“High Level Gravels”)

Open and solid diamond symbols = kimberlite fissures and pipes respectively

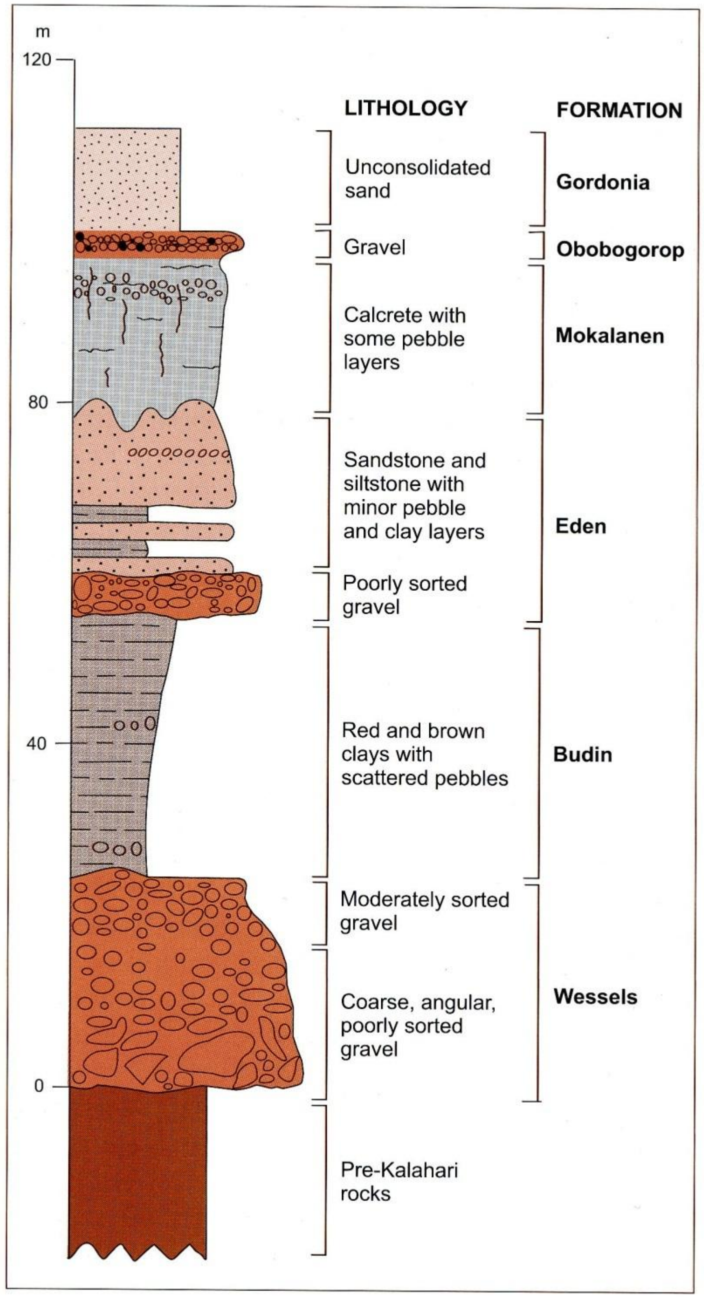

Fig. 5.Stratigraphy of the Kalahari Group (From Partridge *et al.,* 2006). Aeolian sands of the Gordonia Formation as well as calcretesb *possibly* equivalent to the Mokalanen Formation are represented in the study area.

4. PALAEONTOLOGICAL HERITAGE

The fossil heritage recorded within each of the main sedimentary rock successions represented within the Droogfontein study region north of Kimberley is outlined here. See also the summary of fossil heritage provided in Table 1 below.

4.1. Fossils within the Prince Albert Formation

The fossil biota of the post-Dwykamudrocks of the Prince Albert Formation is summarized by Cole (2005) and Almond (2008a, b). Epichnial (bedding plane) trace fossil assemblages of the non-marine *Mermia*Ichnofacies, dominated by the ichnogenera*Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails), are commonly found in basinalmudrockfacies of the Prince Albert Formation throughout the Ecca Basin. These assemblages have been described by Anderson (1974, 1975, 1976, 1981) and briefly reviewed by Almond (2008a, b). A small range of simple, horizontal to oblique endichnial burrows forming dense monospecificichnoassemblages have been recorded from the Ceres Karoo, especially from those parts of the Prince Albert succession containing thin volcanic tuffs (Almond 2010). The presence of more diverse, but incompletely recorded, benthic invertebrate fauna in the Early Permian Ecca Sea is suggested by the recent discovery of complex arthropod trails with paired drag marks in the Prince Albert Formation near Matjiesfontein in the southern Great Karoo.Thesetrackways might have been generated by small eurypterids (water scorpions), but this requires further confirmation. Pooly-defined invertebrate burrows are recorded from the Prince Albert Formation in the Kimberley sheet area by Bosch (1993).

Diagenetic nodules containing the remains of palaeoniscoids (primitive bony fish), sharks, spiral bromalites (coprolites, spiral gut infills*etc* attributable to sharks or temnospondyl amphibians) and petrified wood have been found in the Ceres Karoo (Almond 2008b and refs. therein). Rare shark remains (*Dwykaselachus*) are recorded near Prince Albert on the southern margin of the Great Karoo (Oelofsen 1986). Microfossil remains in this formation include sponge spicules, foraminiferal and radiolarian protozoans, acritarchs and miospores.

The most diverse, as well as biostratigraphically, palaeobiogeographically and palaeoecologically interesting, fossil biota from the Prince Albert Formation is that described from calcareous concretions exposed along the Vaal River in the Douglas area to the west of KImberley (McLachlan and Anderson 1973, Visser *et al.,* 1977-78). The important Douglas biota contains petrified wood (including large tree trunks), palynomorphs (miospores), orthoconenautiloids, 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 (Evans 2005). The invertebrates are mainly preserved as moulds.

4.3. Fossils within the superficial deposits

The fossil record of the **Kalahari Group** is generally sparse and low in diversity. The **Gordonia Formation** dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous 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 bedrocks (including, for example, dolerite) 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 calcretizedrhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008a, 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. Underlying calcretes might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings such as pans) may be expected occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient alluvial gravels.

The “Older” Vaal River Gravels (**Windsorton Formation**) of possible Miocene-Pliocene age have not yet yielded well-dated fossil biotas (Partridge *et al.,* 2006). A ”sparse, poorly provenanced vertebrate fauna from diamond diggings” is noted herein by De Wit *et al.* (2000) who favour a Pliocene age (4.5-3.5 Ma). In contrast, a wide range of Pleistocene mammal remains (bones, teeth) as well as Acheulian stone tools are recorded from the “Younger” Vaal River Gravels or **Rietputs Formation** (Cooke 1949, Wells 1964, Partridge & Brink 1967, Butzer et al. 1973, Helgren 1977, Klein 1984, Bosch 1993). These are assigned to the Mid Pleistocene Cornelian Mammal Age and include various equids and artiodactyls as well as African elephant and hippopotamus (See MacRae 1990, De Wit 2008 for brief reviews, and Gibbon *et al.* 2009 for recent dating of the matrix).

5. SIGNIFICANCE OF IMPACTS ON PALAEONTOLOGICAL HERITAGE

A brief assessment of the significance of the impact of the Droogfontein solar park development on local fossil heritage resources is presented here.

- **Nature of the impact**

Bedrock excavations for the proposed PV panel and CSP mirror supports, buildings, buried cables and pipelines, electrical substation and monitoring station as well as the access and internal site roads, drainage channels, evaporation ponds and powerline infrastructure may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils that are then no longer available for scientific research or other public good. In such flat terrain lay down areas are unlikely to involve bedrock excavation. It is currently unclear if exploitation of potentially fossiliferous bedrock from new or existing borrow pits will be necessary.

- **Extent and duration of the impact**

Significant impacts on fossil heritage are limited to the construction phase when excavations into fresh, potentially fossiliferous bedrock may take place. No further significant impacts are anticipated during the operational phase of the Droogfontein development.

- **Probability of the impact occurring**

Given that the potentially fossiliferous Ecca Group bedrock within the study area is (a) extensively mantled in fossil-poor superficial deposits (*e.g.* Kalahari sands, calcrete), (b) often highly weathered and (c) possibly baked by subsurface dolerite intrusions, while large scale bedrock excavations are not envisaged for this project, a significant impact on palaeontological heritage is considered unlikely.

- **Degree to which the impact can be reversed**

Impacts on fossil heritage are generally irreversible. Well-documented new records of fossils represent a positive impact from a scientific viewpoint.

- **Degree to which the impact may cause irreplaceable loss of resources**

Well-preserved and locally abundant fossils from the Prince Albert Formation, which is present beneath a substantial part of the Droogfontein study area, are already well-known from good rock exposures along the Vaal River in the neighbourhood of Douglas c. 100km to the southwest. In contrast, the Prince Albert bedrocks at Droogfontein are mostly buried beneath several meters of very sparsely fossiliferous Kalahari sands and may well be baked by dolerite intrusion or deeply weathered. The proposed development therefore does not pose a serious threat to local or regional fossil heritage and its impact is therefore rated as of *low significance* in palaeontological terms.

- **Degree to which the impact can be mitigated**

Specialist palaeontological mitigation is *not* regarded as warranted for this project. Should significant fossil remains be exposed during the construction phase of the development, these should be safeguarded, preferably *in situ*, by the ECO and reported to Heritage Western Cape so that appropriate mitigation measures can be considered.

- **Cumulative impacts**

Cumulative impacts cannot be assessed in the absence of reliable data on other development projects approved or proposed in the study region.

6. CONCLUSIONS & RECOMMENDATIONS

The proposed Droogfontein PV and CSP solar plant is underlain at depth by ancient Precambrian lavas of the VentersdorpSupergroup (Allanridge Formation) of Late Archaean age (*c.* 2.7 billion years old) as well as by Early Permian mudrocks of the Ecca Group (Prince Albert Formation). Highly fossiliferous exposures of the last unit are known along the Vaal River at Douglas, *c*. 100km to the south-west. However, at Droogfontein the Prince Albert sediments are almost entirely mantled by several meters of aeolian sands of the Kalahari Group (Gordonia Formation) that are of low palaeontological sensitivity, as are also the associated calcretes. Potentially fossiliferous, fresh (unweathered) Prince Albert rocks are therefore unlikely to be intersected by excavations during construction. Ancient alluvial gravels of the Windsorton Formation are mapped just to the west of the study area but not on Droogfontein itself. Fossiliferous younger gravels may well occur along the banks of the Vaal River here, but are unlikely to be directly affected by the proposed solarparkdevelopment. The overall impact of the proposed development on local fossil heritage is considered to be *low* and specialist palaeontological mitigation for this project is not considered necessary.

Should substantial fossil remains be exposed during construction, however, such as well-preserved fossil fish, reptiles or petrified wood, the ECO should safeguard these, preferably *in situ*, and alert SAHRA as soon as possible so that appropriate action (*e.g.* recording, sampling or collection) can be taken by a professional palaeontologist.

7. ACKNOWLEDGEMENTS

Mnr Wouter Fourie of PGS - Heritage & Grave Relocation Consultants is thanked for commissioning this study and for kindly providing all the necessary background information. The anonymous geotechnical report by Mainstream Renewable Power was a very useful additional resource for this palaeontological study.

TABLE 1: SUMMARY OF FOSSIL HERITAGE IN THE KIMBERLEY AREA				
GEOLOGICAL UNIT	**ROCK TYPES & AGE**	**FOSSIL HERITAGE**	**PALAEONT-OLOGICAL SENSITIVITY**	**RECOMMENDED MITIGATION**
Gordonia Formation *etc* KALAHARI GROUP	unconsolidated to semi-consolidated aeolian sands, locally calcretized at depth QUATERNARY	calcretisedrhizoliths&termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (*e.g.* tortoise) bones, teeth freshwater units associated with diatoms, molluscs, stromatolites*etc*	LOW	none recommended any substantial fossil finds to be reported by ECO to SAHRA
Prince Albert Formation ECCA GROUP	basinalmudrocks with carbonate &phosphatic concretions, minor tuffs EARLY PERMIAN	marine invertebrates (esp. molluscs, brachiopods), coprolites, palaeoniscoid fish & sharks, trace fossils, various microfossils, petrified wood	LOW IN THIS AREA	none recommended any substantial fossil finds to be reported by ECO to SAHRA
Allanridge Formation VENTERSDORP SUPERGROUP	lavas and pyroclastics with minor siliciclastic lenses LATE ARCHAEAN (c. 2.7 Ga)	none	INSENSITIVE	none recommended stromatolites recorded from sediments of underlying Bothaville Formation

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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.

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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 development 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.

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