Figure 9 Rocky soils in the area of the wattle growth in the western section of the site

Figure 10 Rocky soils in the area of the wattle growth in the western section of the site

Figure 11 Dominant vegetation on the western section of the site indicating distinct historical overgrazing (*Seriphium plumosum*)

Figure 12 Shallow and rocky soils as indicated by extensive rock material exposed through ploughing

Figure 13 Shallow and rocky soils as indicated by extensive rock material exposed through ploughing

Figure 14 Shallow and rocky soils as indicated by extensive rock material exposed through ploughing

Figure 15 Deeper soils (60 cm) with moderate agricultural potential

Figure 16 Deeper soils (60 cm) with moderate agricultural potential

5.3 COST-BENEFIT ANALYSIS

A cost-benefit analysis if difficult to conduct due to the shallow nature of the soils and the anticipated regular suppression of yields due to the poor rooting depth and water holding capacity of the soils. In this regard it is concluded that suboptimal yields of maize will occur at a minimum frequency of 5 in every 10 years as the rainfall quantities and distribution vary. This does not apply as strictly for the deeper soils in the surrounding general area. It is therefore concluded that a higher yielding land use (such as solar infrastructure) in monetary terms would always outperform the potential financial benefits of crop production on the specific site. This assumption will change in the event that there is water available for irrigation in which case the financial yield of crop production on the site can be improved.

5.4 CURRENT ACTIVITIES / DEVELOPMENTS / BUILDINGS

The site itself is not characterised by any buildings or developments but, as has been shown in this report, the surrounding areas are characterised by distinct and intensive urban development and expansion.

5.5 SURROUNDING DEVELOPMENTS / LAND USES / ACTIVITIES WITHIN A 500 M RADIUS

Refer to section 5.4. The immediate surrounding soils and land use suffer from the same limitations as the site itself and as such it is not possible to decrease the risks through expansion of the agricultural activities.

5.6 CURRENT STATUS OF LAND

The current status of the land is as described previously in sections 5.2 and 5.3.

5.7 POSSIBLE LAND USE OPTIONS FOR THE SITE

Refer to sections 5.3, 5.4 and 5.5. Within the context of the limitations of the soils on the site the options in terms of agricultural use is for low intensity and low yielding dryland agriculture. From a financial perspective higher yielding land uses, such as solar electricity production, provide a different option with more constant and regular returns.

6. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that:

1. The site is characterised by shallow and rocky soils of the Mispah and Glenrosa forms and slightly deeper soils of the Clovelly an Glencoe forms.
2. The shallow nature of the soils on the site lead to a low yielding dryland agriculture land use and consequently a low general agricultural potential.

3. The agricultural potential can be increased only through the accessing of water for irrigation purposes as the soils are suited to such practices.
4. A cost benefit analysis indicates that other land uses such as solar electricity production will yield higher returns and more constant income on the specific site

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APPENDIX E3

VEGETATION SURVEY

Vegetation survey for the Remaining Extent of the Farm Wheatlands 260 IQ, Gauteng Province

Report Authors: Corné Niemandt (*Cand. Sci. Nat.*)

Reviewed by: J.V. van Greuning (*Pr. Sci. Nat.*)

April 2017

Landscape Architects &
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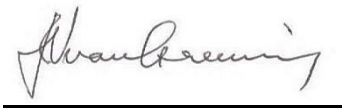
Verification statement

This communication serves to verify that the flora report compiled by Corné Niemandt has been prepared under my supervision, and I have verified the contents thereof.

Declaration of independence: I, Dr. J.V. van Greuning (*Pr. Sci. Nat*. reg. no. 400168/08) declare that I:

- am committed to biodiversity conservation but concomitantly recognise the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them.
- abide by the Code of Ethics of the S.A. Council of Natural Scientific Professions.
- act as an independent specialist consultant in the field of Botany.
- am subcontracted as specialist consultant by Bokamoso Environmental Consultants for the Urban Solar Farms situated on the Remaining Extent of the Farm Wheatlands 260 IQ in this report.
- have no financial interest in the proposed development other than remuneration for work performed.
- have or will not have any vested or conflicting interests in the proposed development.
- undertake to disclose to Bokamoso Environmental Consultants and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2014.



Dr. J. V. van Greuning

Specialist

Specialist investigator: Mr. C. Niemandt (*Cand. Sci. Nat Reg. No. 116598*; *M.Sc. Plant Science*)

Declaration of independence:

I, the above mentioned specialist investigator responsible for conducting this particular specialist flora study, declare that:

• I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;

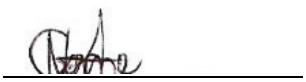
• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part;

• I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience, and scientific data;

• I do not have any influence over decisions made by the governing authorities;

• I have the necessary qualifications and guidance from professional experts (registered *Pr. Sci. Nat*.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;

• This document and all information contained herein are and will remain the intellectual property of Bokamoso Environmental: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the respective specialist investigator.



Corné Niemandt

Cand. Sci. Nat Reg. No. 116598
M.Sc. Plant Science

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1. INTRODUCTION

Bokamoso Environmental: Specialist Division was commissioned to conduct a survey of the vegetation of the study site for a proposed Urban Solar Farm development situated on the Remaining Extent of the Farm Wheatlands 260 IQ, Gauteng Province. The objective of this survey was to determine which species occur in the study site. Special attention was given to possible habitats of Red and Orange List plant species that may occur in the study site. Furthermore, the ecological status of the vegetation and sensitive habitats of the site were investigated.

2. OBJECTIVES OF THE STUDY

- To assess the habitat component of the study site and ecological status of the vegetation;
- To identify and list the plant species occurring on the site and indicate whether they are Threatened species;
- To indicate ecological sensitive areas and habitat connectivity of the study area;
- To highlight the potential impacts of the existing abattoir on the flora of the study area; and
- Provide recommendations to mitigate negative impacts and enhance positive impacts should the existing abattoir become operational again.

3. SCOPE OF THE STUDY

This report:

- Lists all plant species, including alien species, recorded during the site visit;
- Comments on ecological sensitive areas and habitat connectivity;
- Comments on impacts affecting the flora of the study area;
- Evaluates the conservation importance and significance of the study area with special emphasis on the status of threatened species; and
- Provides recommendations to mitigate negative impacts, should the proposed development be approved.

4. LIMITATIONS OF THIS STUDY

Even though considerable care is taken to ensure accuracy and professionalism of this ecological scoping assessment, environmental assessment studies are limited in scope, time and budget. Several years are needed to derive a 100% accurate report based on intensive field collecting and observations where all seasons are considered to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage.

It should be noted that sampling occurred in April 2017 and a second site visit occurred in August 2017 to confirm the location of the two proposed Overhead Power Line Routes. Species sampling was not done during the August 2017 site visit as it was well outside of the sampling season but mainly that it was not considered necessary. The reason for only doing the site visit in August 2017 is that information on the Overhead Power Line Routes were only made available in August 2017 and was not part of the scope of work that took place during April 2017.

The desktop study is an important component of the data used to conclude the distribution of plant species, especially Red List species, which were sourced by making use of the SANBI species list (POSA, 2009). Any limitations in the above mentioned data basis will in effect have implications on the findings and conclusion of this assessment.

Bokamoso Environmental: Specialist Division cannot accept responsibilities for conclusions and mitigation measures made in good faith with the limited available information at the time of the directive. Should any of the information such as maps or kml. files provided to the specialist not be correct for whatever reason, this might have an outcome on the findings of this study. The author of this report cannot be held liable if wrong information were provided by the client and/or EAP. This report should be viewed and acted upon considering these limitations.

5. STUDY AREA

5.1 Regional Vegetation

The study area is located in the Quarter Degree Square (QDS) 2627BA in the Soweto Highveld Grassland, which is regarded as Endangered (Mucina and Rutherford, 2006). The vegetation unit predominantly occurs in areas with shale, sandstone, mudstone or Karoo Suite dolerites and the general composition of the vegetation is characterised by dense, tufted grassland of short to medium height with *Themeda triandra* dominating. Other grasses commonly found include *Heteropogon contortus*, *Elionurus muticus*, *Tristachya leucothrix* and *Eragrostis racemosa*. Only a small portion of the fragmented patches of this vegetation unit are protected with the conservation target at 24%, whilst 23% is transformed. In undisturbed places scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover (Mucina and Rutherford, 2006).

5.2 Study Site

The study site of approximately 19.7 ha (GPS: 26°11'48.86"S, 27°37'1.51"E) is situated on the remaining extent of the farm Wheatlands 260 IQ, Gauteng Province. The study site is situated south of Wheatlands Agricultural Holdings, approximately 8.5 km south-west from Randfontein between the R41 to the north and the R559 to the south. The site can be accessed via Road 6 approximately 0.9 km to the east of the study site (Figure 1).

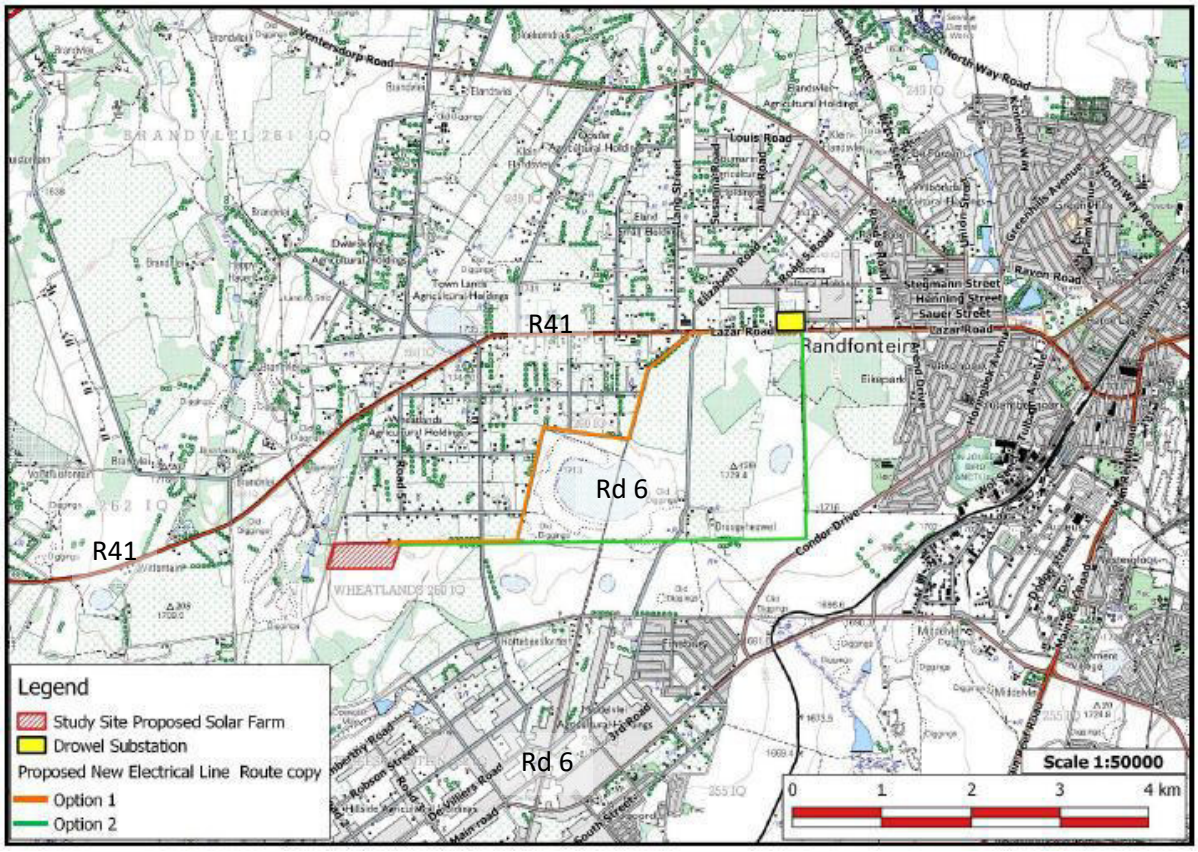

Figure 1: Locality map of study site.

6. METHODS

6.1 Desktop

The **Gauteng Conservation Plan** (C-Plan) v3.3 (2014) was also consulted to identify if any Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Primary Vegetation, Threatened Species and Biodiversity Features such as ridges and wetlands. From the maps generated (Figures 2), the study area is located in an Ecological Support Area (ESA) and a very small portion towards the north-east corner is identified as an Important Area. ESAs are required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas.

Two options are being considered for the Overhead Power Lines (Figure 1). Option 1 and Option 2 of the Overhead Power Line runs through ESA, Important Area and Irreplaceable Area. The Option 1 Route passes through a smaller CBA and runs along Orange List plant habitat, Primary Vegetation and Pan cluster indicated as good quality. The Option 2 route passes through a larger CBA which cuts through Orange List plant habitat, Primary Vegetation and Pan cluster indicated as good quality, and along Pan cluster with Orange List plant species and Primary Vegetation (Figures 2 and 3).

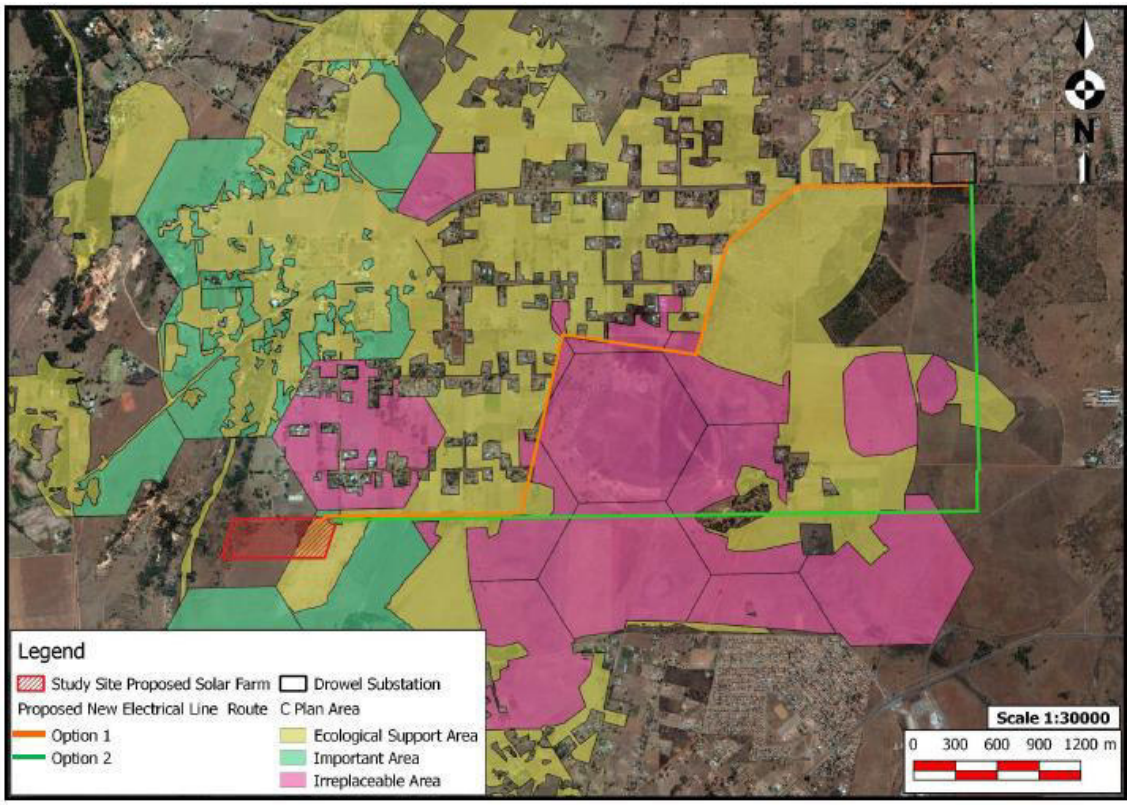

Figure 2: Gauteng Conservation Plan (2014).

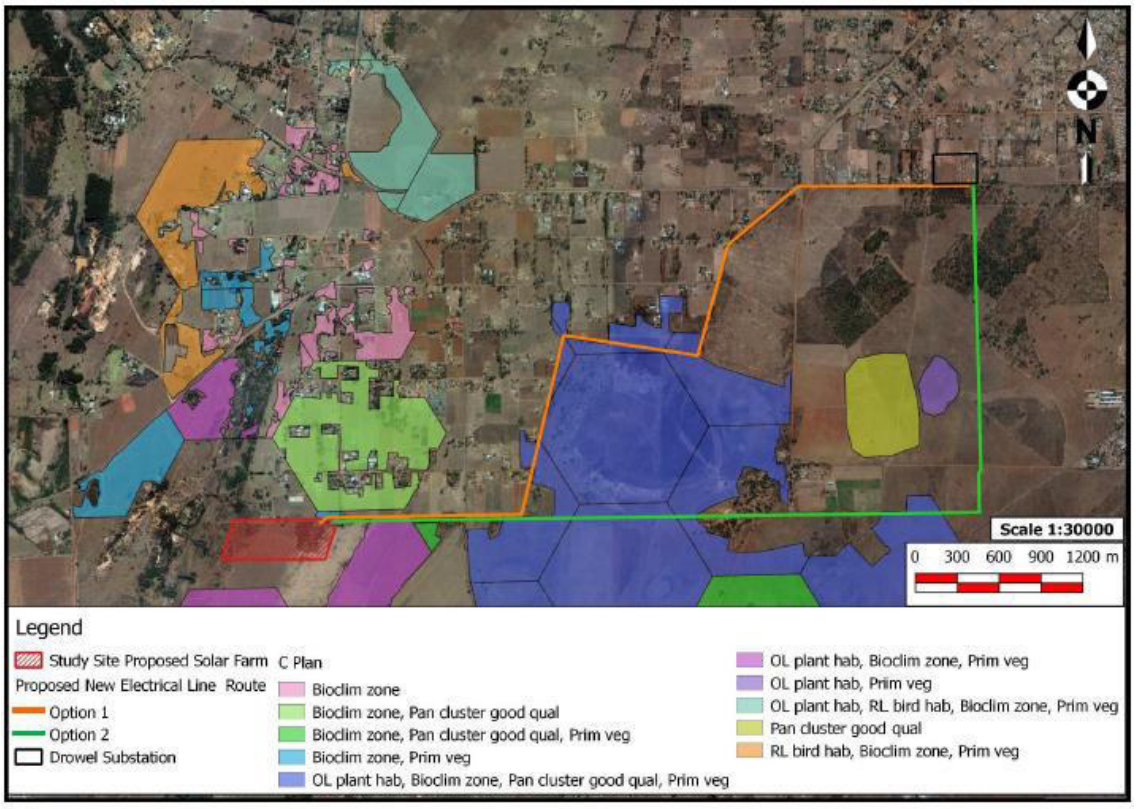

Figure 3: Gauteng Conservation Plan (2014).

6.2 Site Visit

The study site was visited on 4 April and 29 August 2017. For each study unit identified, a species list was compiled for all plants recorded. No study units were identified during the second survey. The two route options for the location of the Overhead power Lines were assessed to determine which one will have the lowest impacts on vegetation and considered feasible. During the April 2017 survey, field guides such as those by Germishuizen and Meyer (2003), Koekemoer *et al*. (2014), Pooley (1998), van Ginkel *et al*. (2011), van Oudtshoorn *et al*. (2014), van Wyk and Malan (1998) and van Wyk (2013) were used to identify the species. The H.G.W.J. Schweickerdt Herbarium, University of Pretoria, was also visited to confirm the correct identification of species if needed.

The survey also included information about the occurrence of Red and Orange List plant species obtained from Gauteng Department of Agriculture and Rural Development for the QDS 2627BA (Pfab, 2002; Pfab and Victor, 2002) (Annexure A). The Red List Plant Species Guidelines and Requirements for Biodiversity Assessments v3. issued by GDARD (2014) was consulted. The plant species list for this QDS obtained from SANBI (Plants of Southern Africa: an online checklist) was consulted to verify the record of occurrence of the plant species recorded at the site. The Gauteng Conservation Plan (C-plan v3.3) was also consulted to evaluate ecologically sensitive areas.

Each study unit was further scrutinised for the occurrence of alien plant species (Bromilow, 2010) and any form of disturbance. Alien species are included in the species lists (in bold in the relevant tables) as they suggest the particular state of each study unit. For each alien species the Category is indicated according to the *Alien and Invasive Species lists* (NEMBA Alien and Invasive Species Lists, 2016).

For each plant species, the medicinal properties were assessed (van Wyk *et al*., 2013). Medicinal plants are marked with an asterisk in the respective tables. Harvesting of medicinal plants causes a decline in numbers of the particular species and, therefore, threatens the conservation of these species.

7. RESULTS

7.1 Study units

Three study units were identified for the April 2017 survey (Figure 4):

1. Grassland
2. Disturbed Grassland
3. Transformed area

Accordingly, information to follow is only applicable to the April 2017 survey. As mentioned above, no study units were identified for the August 2017 survey as sampling was not possible. It should be noted that recommendations, mitigation measures and sensitivity maps include both the study site and the proposed Overhead Power Line Routes of approximately 7km long.

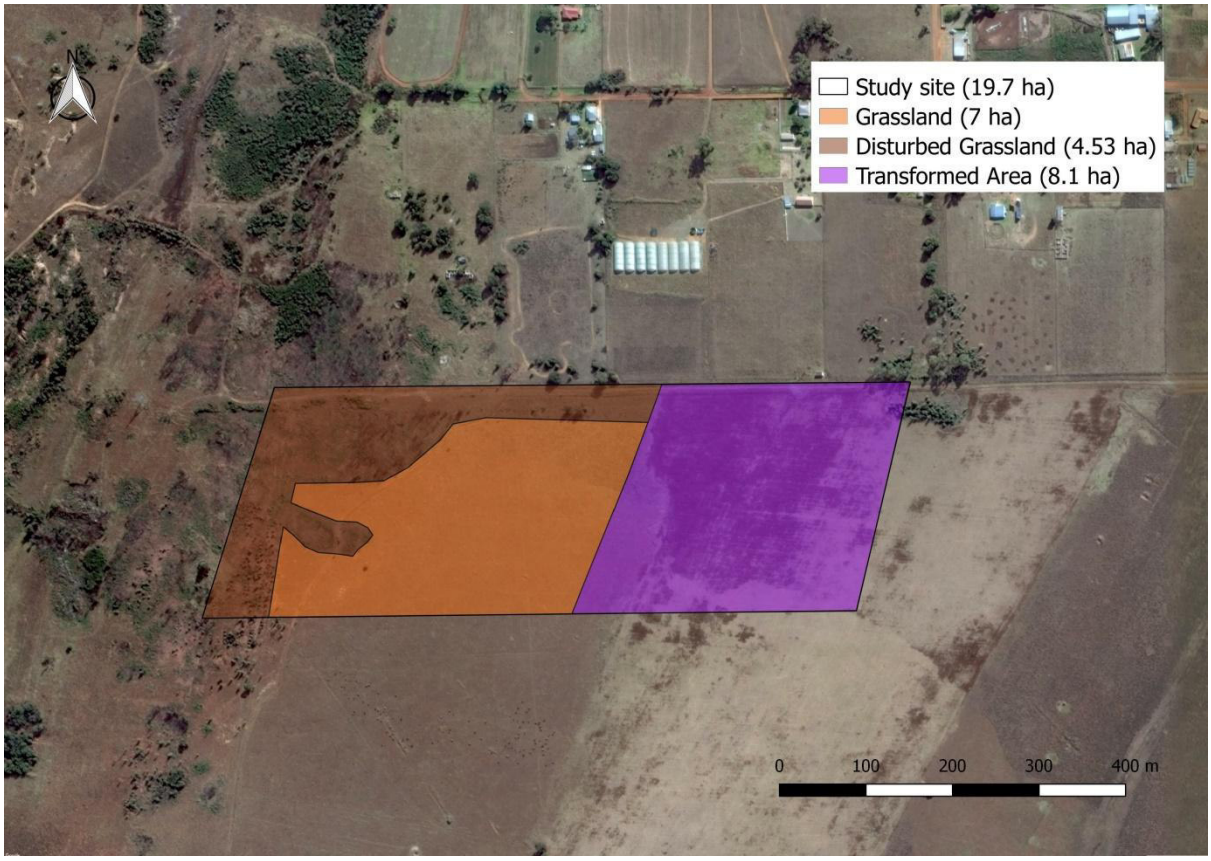

Figure 4: Study units identified.

7.2 Medicinal and Alien plant species

The total number of plant species, medicinal and alien species recorded per study unit is listed in Table 1. The Transformed area is excluded since only a few alien species were recorded.

Table 1: The total number of plant species, the number of medicinal species and alien species recorded per study unit.

Study unit	Total number of species per unit	No. of medicinal species per unit	No. of alien species per unit
Grassland	32	2	4
Disturbed Grassland	23	1	7

The number of alien plant species per Category is indicated in Table 2. For each alien species the Category is indicated according to the amended Alien and Invasive Species (AIS) lists (NEMBA Alien and Invasive Species Lists, 2016) in Government Notice 40166 in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004). The AIS Regulations list 4 different categories of invasive species that must be controlled, managed or eradicated:

Category 1a: Invasive species which must be combatted and eradicated. Any form of trade or planting is strictly prohibited.

Category 1b: Invasive species which must be controlled and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited.

Category 2: Invasive species or species deemed to be potentially invasive, in that a permit is required to carry out a restricted activity. Species include commercially important species such as pine (*Pinus* spp.), wattle (*Acacia* spp.) and gum (*Eucalyptus* spp.) trees. Plants in riparian areas are Category 1b.

Category 3 Invasive species which may remain in prescribed areas and provinces. Further planting, propagation or trade is however prohibited. Plants in riparian areas are Category 1b.

Alien plant species and their respective Category are indicated in bold in the species lists (Tables 3 and 4).

Table 2: Number of alien plant species per study unit.

Study unit	CAT 1a	CAT 1b	CAT 2	CAT 3	Not declared invasive
Grassland	0	2	0	0	2
Disturbed Grassland	0	4	0	0	3

7.3 Red and Orange List plant species

Twelve Red and Orange List species are known to occur in the QDS 2627BA (Annexure A). The study site has suitable habitat for one Red List species and one Orange List species of which *Boophone disticha* was recorded during the survey (Annexure A).

7.4. Grassland

7.4.1. Composition

The Grassland has some characteristics of the Soweto Highveld Grassland (Figure 5), but is under severe pressure from surrounding land uses including agricultural lands. A total of 32 species were recorded in the Grassland. Dominant species include *Cleome maculata, Eragrostis racemosa, Hyparrhenia hirta, Monocymbium ceresiiforme, Seriphium plumosum, Schizachyrium sanguineum* and *Themeda triandra.*

Table 3: Species recorded in the Grassland.

Species	Invasive category
Acacia mearnsii	**1b**
Aristida congesta subsp. *congesta*	
Aristida stipitata subsp. *graciliflora*	
Bidens pilosa	
*Boophone disticha**	
Bulbostylis cf. *hispidula*	
Cleome maculata	
Cymbopogon cf. *caesius*	
*Dicoma anomala**	
Digitaria eriantha	
Eragrostis chloromelas	

Eragrostis curvula	
Eragrostis racemosa	
Geigeria ornativa	
Helichrysum cf. *rugulosum*	
Heteropogon contortus	
Hyparrhenia hirta	
Hypoxis iridifolia	
Hypoxis rigidula	
Indigofera sp.	
Melinis nerviglumis	
Melinis repens	
Monocymbium ceresiiforme	
Nidorella anomala	
Pogonarthria squarrosa	
Schizachyrium sanguineum	
Senecio coronatus	
Senecio venosus	
Seriphium plumosum	
Solanum sisymbriifolium	**1b**
Tagetes minuta	
Themeda triandra	

Alien species indicated in **bold**; Medicinal species indicated with (*)

7.4.2. Medicinal and Alien plant species

Two medicinal and four alien species have been recorded in the study unit (Table 3).

7.4.3. Red and Orange List species

The study unit has suitable habitat for one Red List species and one Orange List species, of which the Orange List species was recorded during the survey (Annexure A).

7.4.4. Sensitivity and Connectivity

The Grassland is connected with surrounding grasslands towards the south and south-east but is regionally restricted due to habitat loss and fragmentation caused by increased agricultural lands as well as increased alien species density. The proposed development could cause habitat loss but will not necessarily act as a barrier for dispersal or gene flow between sites. The Grassland has high sensitivity.

Figure 5: Grassland.

7.5. Disturbed Grassland

7.5.1. Composition

The Disturbed Grassland is not considered characteristic of the Soweto Highveld Grassland due to agricultural use causing increased habitat loss as well as increased alien species density and abundances (Figure 6). A total of 23 species were recorded during the survey (Table 4). The study unit is dominated by *Acacia mearnsii* towards the western and north-western section of the study site. Other dominant species include *Seriphium plumosum, Tagetes minuta, Cleome maculata, Monocymbium ceresiiforme, Melinis nerviglumis, Solanum sisymbriifolium* and *Eragrostis racemosa.*

Table 4: Species recorded in the Disturbed Grassland.

Species	Invasive category
Acacia mearnsii	**1b**
Aristida congesta subsp. *congesta*	
Bidens pilosa	
Cleome maculata	
Datura stramonium*	**1b**
Eragrostis curvula	
Eragrostis racemosa	
***Eucalyptus* sp.**	
Gladiolus sp.	

Helichrysum sp.	
Hypoxis iridifolia	
Hypoxis rigidula	
Melinis nerviglumis	
Monocymbium ceresiiforme	
Nidorella anomala	
Senecio coronatus	
Senecio sp.	
Seriphium plumosum	
Schizachyrium sanguineum	
Solanum mauritianum	**1b**
Solanum sisymbriifolium	**1b**
Tagetes minuta	
Themeda triandra	

Alien species indicated in **bold**; Medicinal species indicated with (*)

7.5.2. Medicinal and Alien plant species

One medicinal and seven alien species were recorded during the site visit (Table 4).

7.5.3. Red and Orange List species

The study unit has suitable habitat for one Orange List species (Annexure A). None were recorded during the survey.

7.5.4. Sensitivity and Connectivity

The Disturbed Grassland is being transformed by alien species such as *Acacia mearnsii* and *Eucalyptus* sp. Connectivity for indigenous species occurring in this study unit could be limited due to the density of alien species. The proposed development will not necessarily act as a barrier for dispersal or gene flow between sites. It is suggested that the Disturbed Grassland has a low sensitivity.

Figure 6: Disturbed Grassland.

7.6. Transformed area

A survey was not conducted for this study unit as the vegetation has been transformed to agricultural land with no indigenous species (Figure 7). Species observed include *Tagetes minuta, Datura stramonium, Pennisetum clandestinum, Cleome maculata* and *Eucalyptus* sp. The Transformed area is not considered sensitive from an ecological perspective.

Figure 7: Transformed area with *Tagetes minuta, Cleome maculata* and *Datura stramonium*.

7.7. Overhead Power Line Routes

As mentioned, no survey was undertaken for the two route options for the location of the proposed Overhead Power Line as it falls outside the sampling season, but mainly because a survey for the study site was conducted in April 2017. The two route options are not considered part of the study site. A general idea of the area and the proposed impacts were noted during the site visit. The Option 1 route runs along an existing dirt road where disturbance is evident. High alien species density and numbers occur along Option 1 with increased edge effects from the surrounding human activities (Figure 8). Alien species include *Acacia* spp., *Eucalyptus* sp., *Tagetes minuta* and *Opuntia* sp. The Option 2 route runs between three pans and over a rocky area which are considered sensitive. The Option 2 route does not seem to be following an existing route, but crosses over several land uses including grassland, alien vegetation and rocky areas (Figure 9). Based on the site visit, Option 1 route is preferred as it will have the lowest impact on the vegetation compared to Option 2.

Figure 8: Option 1 route along dirt road. Grassland has been burnt and alien vegetation such as *Acacia* spp., and *Eucalyptus* sp. occur along the road.

Figure 9: Option 2 route running along rocky areas and grassland.

8. FINDINGS

The Grassland has some characteristics of the Soweto Highveld Grassland, but is under severe pressure from surrounding land uses such as expanding agricultural land and small-holdings. One Orange List species, *Boophone disticha*, was recorded in the Grassland. The proposed development could lead to habitat loss and fragmentation but will not necessarily act as a barrier for dispersal or gene flow. A proposed mixed-use development approximately 0.9 km east of the study area has recently been approved. Connectivity and less habitat loss and fragmentation for the Soweto Highveld Grassland is critical, therefore, corridors towards the south-west, north-west and north-east should be maintained, especially Ecologically Support Areas as defined by GDARD (2014). Based on the results, the Grassland has high sensitivity (Figure 10). All primary grasslands, even if it is in a poor or degraded condition, should be indicated as ecologically sensitive (GDARD, 2014).

The Disturbed Grassland is dominated by *Acacia mearnsii* and is not considered typical of the Soweto Highveld Grassland. The Disturbed Grassland could act as a barrier for dispersal or gene flow towards the west, and threatens the ecological integrity of the Grassland as it reduces the number of indigenous species, mainly due to an increase in alien species numbers and density. The Disturbed Grassland is considered to have moderate sensitivity (Figure 10).

The Transformed area has been modified to such an extent that it is not considered characteristic of the Soweto Highveld Grassland. The alien species could potentially spread into the Grassland which could cause a decline in indigenous species abundance and diversity. The Transformed area is considered to have low sensitivity (Figure 10).

Option 1 route of the proposed Overhead Power Line Routes is preferred as it has a lower impact on the vegetation. Habitat loss and fragmentation for Option 1 is lower compared to Option 2, it runs through already disturbed sites mostly along dirt roads where alien species numbers and density are higher.

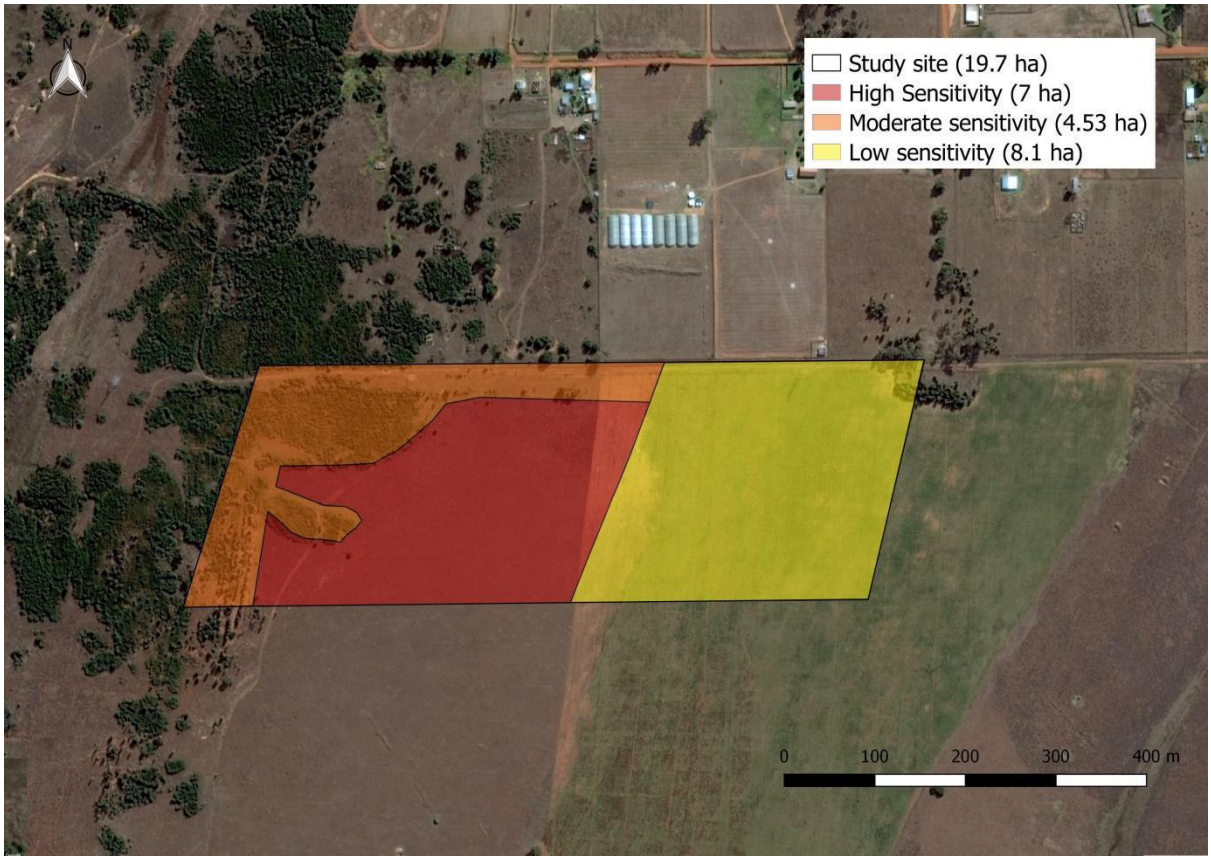

Figure 10: Sensitivity map of the study site.

9. RECOMMENDATION AND MITIGATION MEASURES

The following general recommendations and mitigation measures are suggested for the study area:

- The attached sensitivity map (Figure 10) should be used as a guideline during the layout planning;
- A post-construction alien and invasive control, monitoring and eradication programme must be implemented along with an on-going programme to ensure persistence of indigenous species. This should especially occur along/under the Overhead Power Line. A qualified botanist/ecologist should compile and supervise the implementation of this programme;
- The Orange List species located on the study site should be relocated to a suitable area. It is suggested to contact GDARD with regards to the relocation of this species as well as a qualified specialist in the field of botany;
- The Grassland has suitable habitat for one Red List species (Annexure A). If approved and this species is found on site, the Environmental Control Officer (ECO) should be notified immediately and construction activities should be stopped. The ECO will then contact a plant specialist and inform GDARD;
- Maintenance of the vegetation under the Overhead Power Line servitude should occur on a regular basis (at least twice a year).

10. CONCLUSION

Should the proposed Urban Solar Farm development be approved, the above-mentioned recommendations should be included as part of the Environmental Management Programme, and implemented by the Environmental Control Officer. It is suggested that a site alternative be considered towards the east of the proposed site where the vegetation is more disturbed. The feasibility of this should be evaluated by the EAP. Option 1 of the Overhead Power Line is preferred as it will have the lowest impact on the environment. Option 2 should not be considered as an alternative route. According to GDARD (2014) all primary grasslands, even if it is in a poor or degraded condition, should be indicated as ecologically sensitive (Figure 10). This Grassland is surrounded by disturbed areas including historical cultivation and alien vegetation. It is however well connected with similar vegetation to the south and is part of a larger grassland patch consisting of approximately 62 ha. Although the study site is not regarded as Primary Vegetation and Orange List Plant Habitat according to GDARD C-Plan (2014), it should be reconsidered owing to the presence of *Boophone disticha* and the good ecological conditions on site which is similar to the surrounding grassland.

Should the proposed development be approved, *Boophone disticha* on site should be relocated to suitable locations before construction activities commence. A plant specialist and GDARD should be contacted with regards to the relocation of this species. Furthermore, alien plant species, especially in Category 1 and 2 must be eradicated as part of a management plan.

11. LITERATURE

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The following information is to remain confidential and is not meant for the general public. Please do not distribute under any circumstances without the permission from GDARD.

Annexure A: Red List Species (confidential)

The following Red List species are listed for the quarter degree square 2627BA according to GDARD. An indication is also provided if suitable habitat exist for each species.

SPECIES	FLOWERING SEASON	SUITABLE HABITAT	CONSERVATION STATUS ([1]global; [2]national)	SUITABLE HABITAT
Boophone disticha	**October-January**	**Dry grassland and rocky areas.**	**Declining[2]**	**Yes – Recorded on site**
Bowiea volubilis subsp. *volubilis*	September-April	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest.	Vulnerable[2]	No
Callilepis leptophylla	August-January & May	Grassland or open woodland, often on rocky outcrops or rocky hillslopes.	Declining[2]	No
Delosperma leendertziae	October – April	Rocky ridges; on rather steep south facing slopes of quartzite in mountain grassveld.	Near Threatened[1]	No
Habenaria mossii	March-April	Open grassland on dolomite or in black sandy soil.	Endangered[1]	No
Holothrix randii	September-October	Grassy slopes and rock ledges, usually southern aspects.	Near Threatened[2]	No
Ilex mitis var. *mitis*	October-December	Riverbanks, streambeds, evergreen forests.	Declining[2]	No
Khadia beswickii	July-April	Open areas on shallow surfaces over rocks in grassland.	Vulnerable[1]	No – Recorded within 5km of the study site
Lithops lesliei subsp. *lesliei*	March-June	Primary habitat appears to be the arid grasslands in the interior of South Africa where it usually occurs in rocky places, growing under the protection of surrounding forbs and grasses.	Near Threatened[2]	No
Melolobium subspicatum	September-May	Grassland.	Vulnerable[1]	Yes

Pearsonia bractiata	December-April	Plants in Gauteng and North West occur in gently sloping Highveld grassland, while those in the Wolkberg were collected from steep wooded slopes and cliffs in river valleys.	Near Threatened[1]	No
Prunus africana	December – June	Forests, bushveld.	Vulnerable[2]	No

APPENDIX E4

FAUNA HABITAT ASSESSMENT

Fauna Habitat Assessment for Remaining Extent of the Farm Wheatlands 260 IQ, Gauteng Province

Report Author: Corné Niemandt

Reviewed by: Koos de Wet (*Pr.Sci.Nat.* 40043/89)

April 2017

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Specialist investigator: Mr. C. Niemandt (*Cand.Sci.Nat Reg. No. 116598*; *M.Sc. Plant Science*)

Declaration of independence:

I, the above mentioned specialist investigator responsible for conducting this particular specialist fauna habitat assessment, declare that:

• I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;

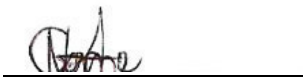
• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part;

• I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience, and scientific data;

• I do not have any influence over decisions made by the governing authorities;

• I have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;

• This document and all information contained herein are and will remain the intellectual property of Bokamoso Environmental: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the respective specialist investigator.



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Cand.Sci.Nat Reg. No. 116598
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1. INTRODUCTION

Bokamoso Environmental Consultants CC: Specialist Division was appointed to conduct a Basic Faunal Habitat Assessment for an Urban Solar Farm situated on the Remaining Extent of the Farm Wheatlands 260 IQ, Gauteng Province. No layout map was available at the time of this survey. This report is based on the faunal species that could potentially occur on the study area. The report acts as an overview of the probable and/or known occurrence of following faunal groups: Mammals, Reptiles, Amphibians, and Invertebrates. Avifauna was done as a separate assessment. The primary focus of this report falls on Red Listed species, including Critically Endangered, Endangered and Vulnerable (IUCN, 2016), and species of conservation concern (SCC)[1] occurring on or near the study area. This is to ensure that if present, the appropriate actions are taken to reduce impacts and protect species and their natural environment.

2. SCOPE AND OBJECTIVE OF ASSESSMENT

- To qualitatively assess the significance of the habitat components and current general conservation status of the property;
- Comment on ecologically sensitive areas within the study area;
- Comment on connectivity with natural vegetation and homogeneous habitats surrounding the study area;
- To provide a list of faunal species which occur or might occur, and to identify Threatened species and/or SCC;
- Make recommendations if any Threatened and/or SCC are found;
- To highlight potential impacts of the proposed development on the fauna judged to be present on the study area; and
- Provide recommendations to mitigate against negative impacts and potentially create positive impacts should the proposed development be approved.

3. LIMITATIONS

Even though considerable care is taken to ensure accuracy and professionalism of this ecological assessment, environmental assessment studies are limited in scope, time and budget. Sampling conducted across several phenological seasons is required to accurately produce a comprehensive species inventory and ecological understanding for the environment studied. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. However, due to EIA timeframes, allocated specialist time and budget, Bokamoso Environmental Consultants cannot be held responsible for incorporating such information after the final delivery of this document unless additional budget and time is allocated.

[1] SCC are species that have a high conservation importance and include not only Red Listed species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD).

It should be noted that sampling occurred in April 2017 and a second site visit occurred in August 2017 to confirm the location of the two proposed Overhead Power Line Routes. The reason for only doing the site visit in August 2017 is that information on the Overhead Power Line Routes were only made available in August 2017 and was not part of the scope of work that took place during April 2017.

The desktop study used to conclude Threatened species and/or SCC in the Quarter Degree Square were sourced from of the Animal Demography Unit (ADU): Virtual Museum (VM)[2] data basis (ADU, 2017). Any limitations in the above mentioned data bases will in effect have implications on the findings and conclusion of this assessment. Should any of the information such as maps or kml. files provided to the specialist not be correct for whatever reason, this might have an outcome on the findings of this study. The author of this report cannot be held liable if wrong information were provided by the client and/or EAP. Accordingly, this report should be viewed and acted upon considering these limitations.

4. STUDY AREA

The study site of approximately 19.7 ha (GPS: 26°11'48.86"S, 27°37'1.51"E) is situated on the remaining extent of the farm Wheatlands 260 IQ, Gauteng Province. The study site is situated south of Wheatlands Agricultural Holdings, approximately 8.5 km south-west from Randfontein between the R41 to the north and the R559 to the south. The site can be accessed via Road 6 approximately 0.9 km to the east of the study site (Figure 1). In addition, two options are being considered for the Overhead Power Lines (Figure 1).

[2] http://vmus.adu.org.za/

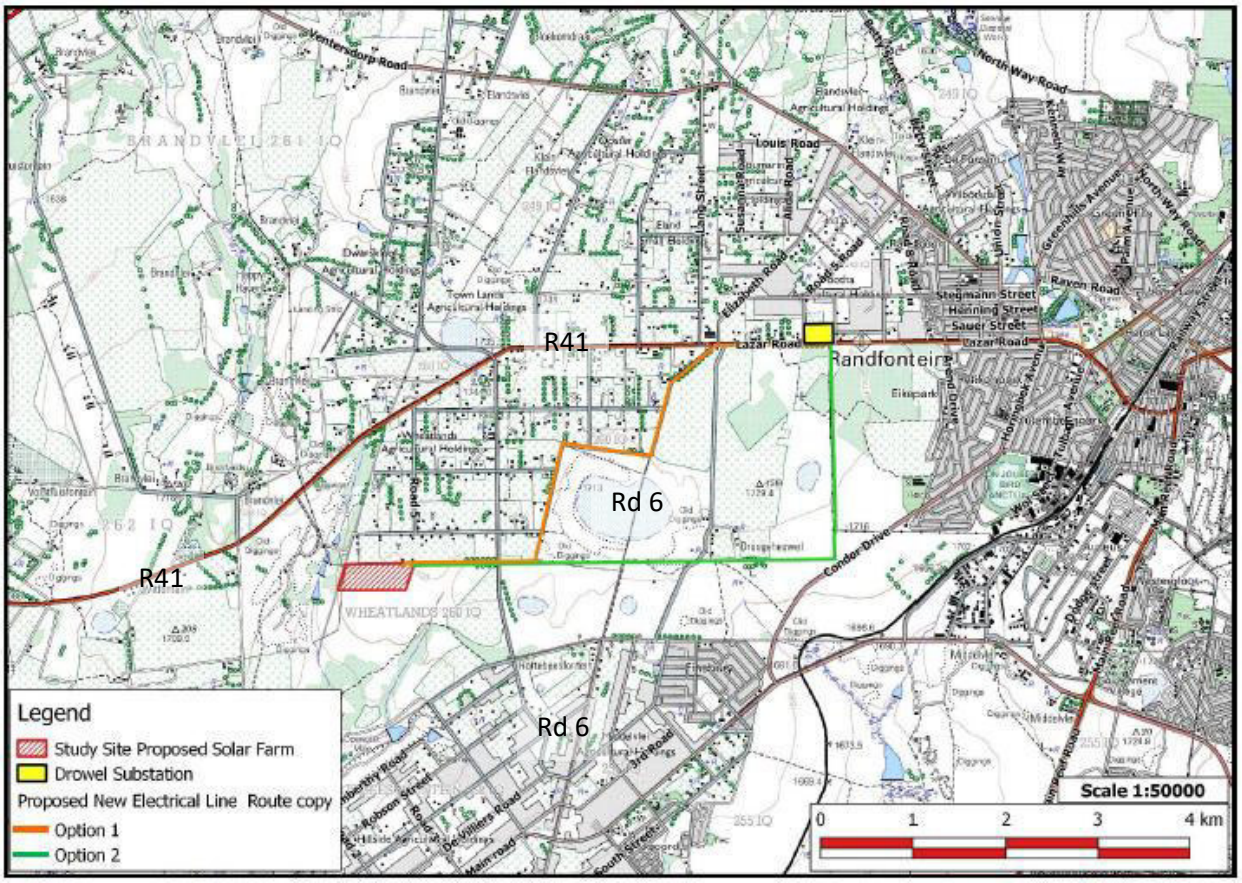

Figure 1: Location of study area.

4.1 Regional Vegetation

The study area is located in the Quarter Degree Square (QDS) 2627BA in the Soweto Highveld Grassland (Mucina and Rutherford, 2006). The Soweto Highveld Grassland has also been classified as a threatened ecosystem which is regarded as vulnerable (Government Gazette, 2011). It predominantly occurs in areas with shale, sandstone, mudstone or Karoo Suite dolerites and the general composition of the vegetation is characterised by dense, tufted grassland of short to medium height with *Themeda triandra* dominating. Other grasses commonly found include *Heteropogon contortus*, *Elionurus muticus*, *Tristachya leucothrix* and *Eragrostis racemosa*. Only a small portion of the fragmented patches are protected with the conservation target at 24%, whilst 23% is transformed. In undisturbed places, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover (Mucina and Rutherford, 2006).

5. METHODS

A desktop assessment was conducted prior to the site visit to obtain the expected fauna species to occur in the study area based on their individual habitat preferences. A list of expected species was compiled

and used as a reference during the field survey to ensure that faunal species that should theoretically occur were not overlooked. All discrete faunal habitats were identified on site, after which each habitat was assessed to record the associated faunal species for each of the respective faunal group (Mammals, Reptiles, Amphibians, and Invertebrates) present in that specific habitat.

Desktop Survey

A desktop study was done prior to the site visit to compile a species list of each faunal group (Mammals, Amphibians, Reptiles and Invertebrates) which might occur on the study area as well as possible Red Listed species and SCC known to occur in the 2627BA QDS. The ADU: VM[3] (ADU, 2017) was consulted to verify the records and occurrence of recorded mammal species in the 2627BA QDS. The majority of faunal species are either nocturnal, poikilothermic, hibernators, secretive and seasonal, which makes it difficult to observe them during field surveys. Therefore a number of authoritative tomes such as field guides, datasets and scientific literature were utilized to deduce the probable occurrence of faunal species.

The **Gauteng Conservation Plan** (C-Plan) v3.3 (2014) was also consulted to identify if any Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Primary Vegetation, Threatened Species and Biodiversity Features such as ridges and wetlands. From the maps generated (Figures 2), the study area is located in an Ecological Support Area (ESA) and a very small portion towards the north-east corner is identified as an Important Area. ESAs are required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas.

Option 1 and Option 2 of the Overhead Power Line runs through ESA, Important Area and Irreplaceable Area. The Option 1 Route passes through a smaller CBA and runs along Orange List plant habitat, Primary Vegetation and Pan cluster indicated as good quality. The Option 2 route passes through a larger CBA which cuts through Orange List plant habitat, Primary Vegetation and Pan cluster indicated as good quality, and along Pan cluster with Orange List plant species and Primary Vegetation (Figures 2 and 3).

[3] http://vmus.adu.org.za/

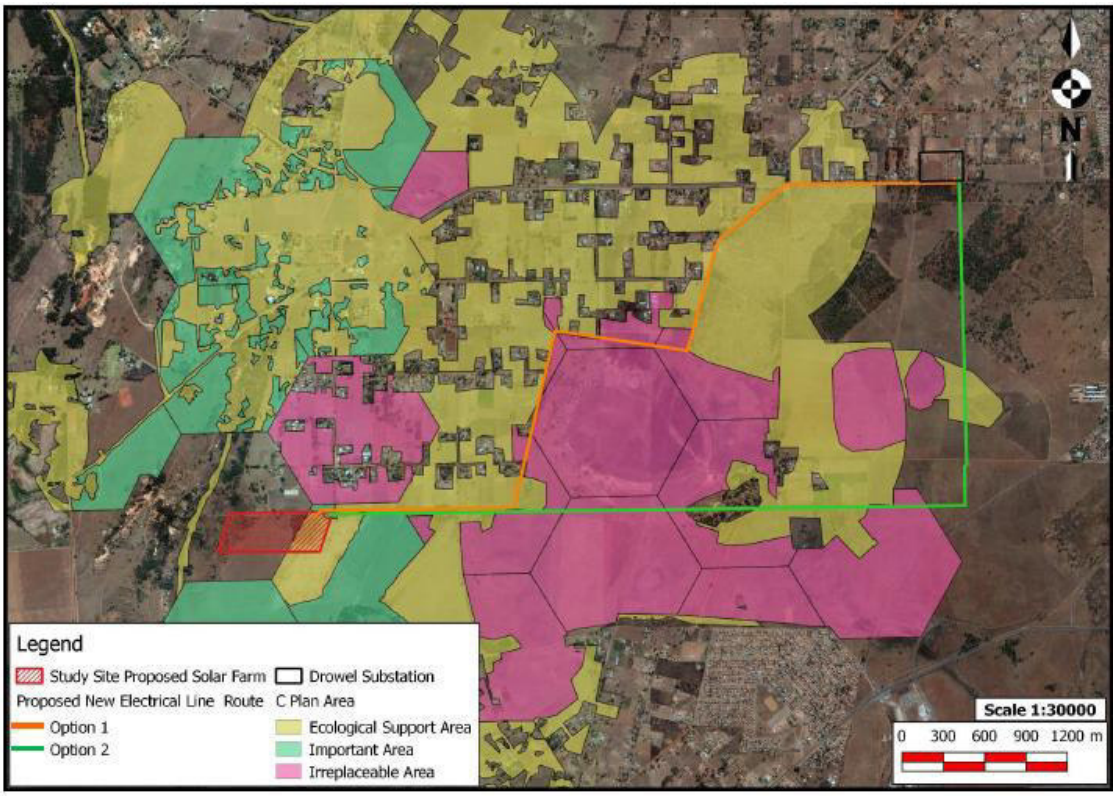

Figure 2: Gauteng Conservation Plan (2014).

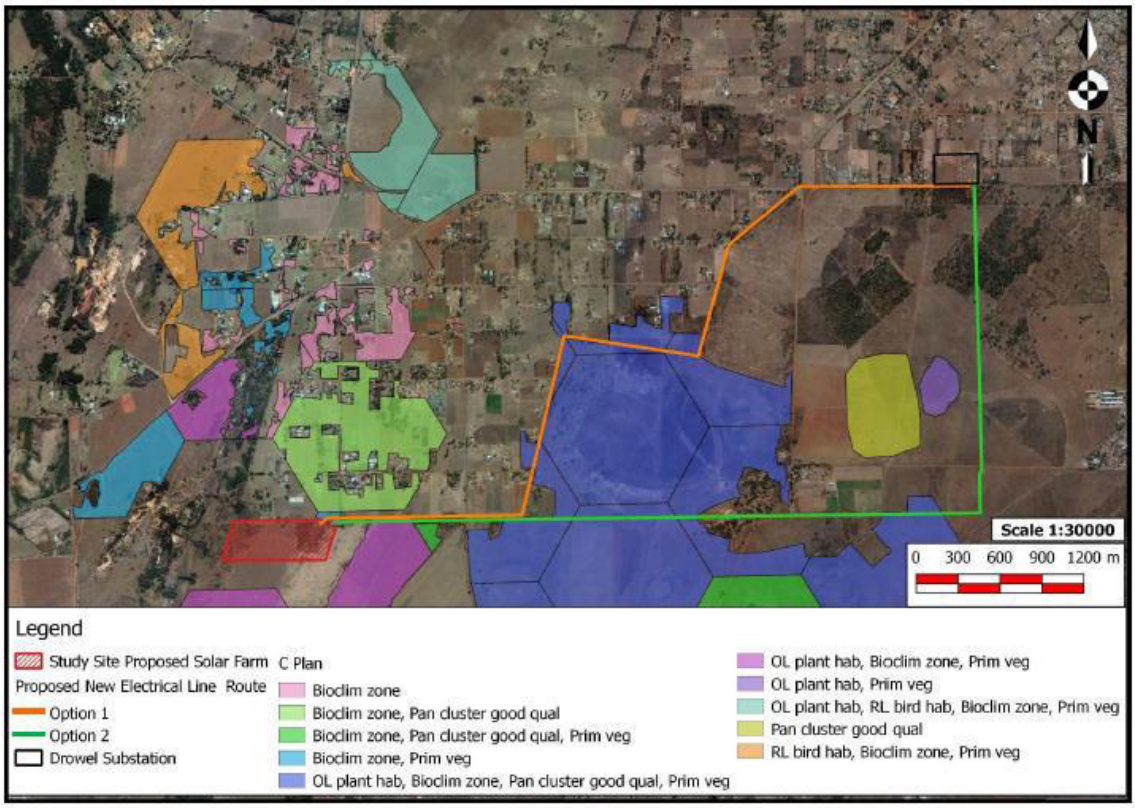

Figure 3: Gauteng Conservation Plan (2014).

The **Gauteng Province Environmental Management Framework** (GPEMF, 2014) is to guide sustainable land use management within the Gauteng Province. From the Gauteng Provincial Environmental Management Framework (GPEMF) the development of Five Environmental Management Zones were derived by information from the Status Quo elements, the Desired State elements as well as Sensitivity Assessment (GPEMF, 2014). According to the GPEMF (2014), the study area is located in Zone 3: High control zone (outside the urban development zone) and Zone 4: Normal control zone (Figure 4).

Zone 3 is described as a special control zone which is sensitive areas outside the urban development zone. These areas are sensitive to development activities and in several cases also have specific values that need to be protected. Conditions in Zone 3 include:

- *No listed activities may be excluded from environmental assessment requirements in this zone and further activities may be added where necessary to protect the environment in this zone.*
- *Additional requirements (guidelines, precinct plans, etc.) to ensure the proper development of identified areas in this zone, in a manner that will enhance their potential for conservation, tourism and recreation may be introduced.*

Zone 4 is dominated by agricultural uses outside the urban edge. Agriculture is a primary activity in this zone and new development activities that would impact on agriculture potential in this zone should be assessed and reconsidered.

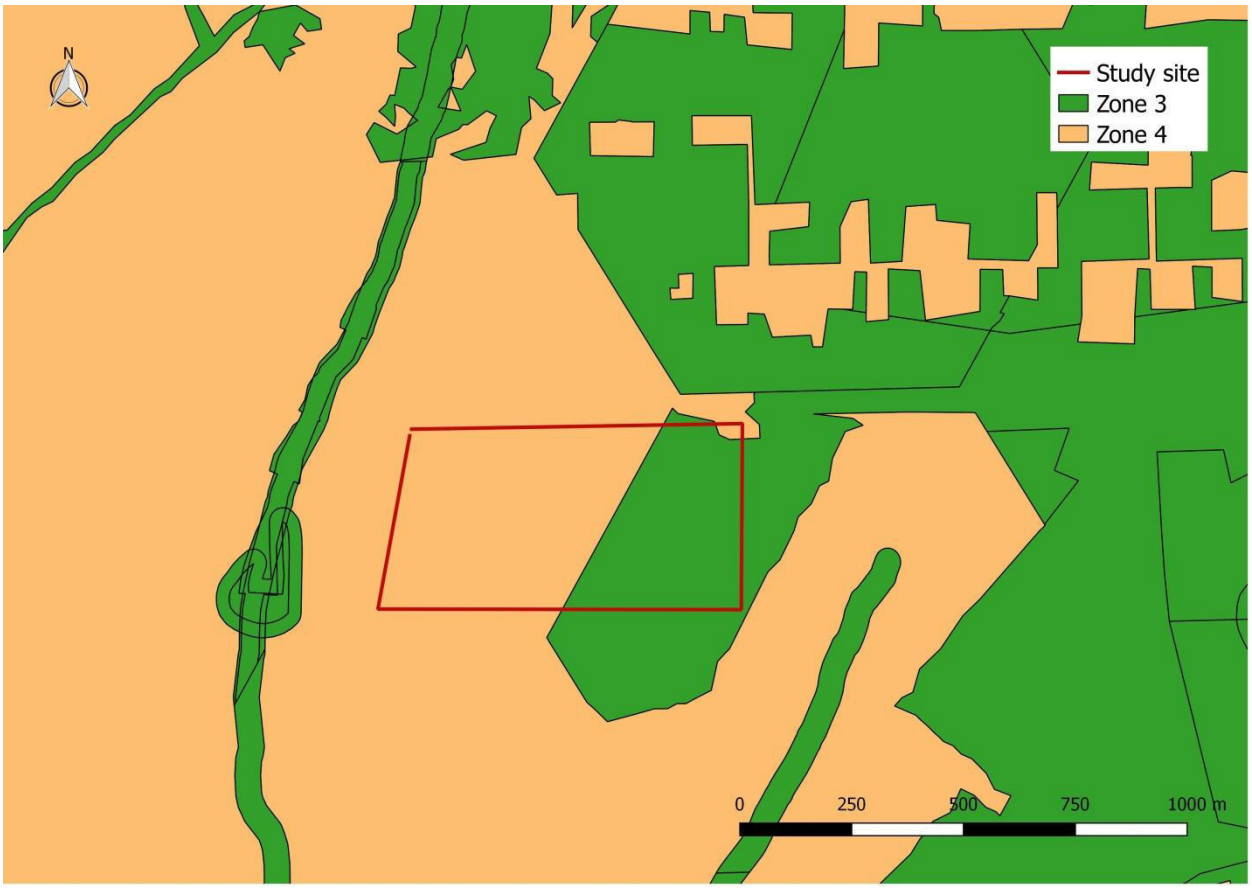

Figure 4: Gauteng Province Environmental Management Framework – Zone 3 and 4.

Mammals

A comprehensive list of probable mammalian occurrence with reference to the study area was compiled on account of the well-known and documented distributions of mammals in South Africa, especially in the Gauteng Province. The probability of occurrence (POO) of mammal species was deduced in accordance with a species' distribution and habitat preferences. Where a species distribution range was found to overlap with the study area and its preferred habitat was present, the applicable species was deemed to have a high POO on or near the study area. In the case where the preferred habitat of a species was found to be suboptimal on the study area, however its distribution range still overlapped the study area, the applicable species POO was deemed to be medium. When the preferred habitat of a species was absent from the study area, the applicable species was deemed to have a low POO regardless of its distribution range.

Herpetofauna

Habitat units identified within the study area were documented, and a combined species list was compiled for the possible presence of herpetofauna species, considering the knowledge of their preferred habitats. Field guides such as those of Marais (2004), Alexander & Marais (2007), and du Preez & Carruthers (2009), were used for habitat description of herpetofauna species.

Invertebrates

Habitat characteristics for Red Listed species were derived from the field survey. Species conservation status was considered based on Henning *et al*., (2009) and Mecenero *et al*., (2013).

Site visit

A three hour site visit was conducted on 4 April 2017, during which all faunal habitats and species observed on the study area were identified by visual sightings. No trapping or mist netting was conducted in this assessment, but focused mainly on the identification of faunal habitats. A second site visit was done on 29 August 2017 to assess the locations of the proposed Overhead Power Lines Routes. Before the commencement of the April field survey a list of expected species was compiled to use as a reference in the field. Also, a list of expected Red Listed species and SCC was obtained from GDARD. All the Red Listed species with distribution ranges overlapping the study area were included in the reference list. These species were prioritized and special attention was paid in terms of identifying their associated habitat preferences and noting signs of their possible presence. The field survey was conducted by means of random transect walks in each habitat.

Sensitivity and Probability of Occurrence

The combined habitat sensitivity was calculated as an average of the numerical values across all of the zoological disciplines[4]. The resulting sensitivity map displayed below show a colour gradient from red (Very High sensitivity) to yellow (Very Low sensitivity) (Figure 8). Orange indicates moderate sensitivity. Although this manner of combining habitat sensitivities into a single map may not be ideal, it does have the benefit of being able to indicate unanimous agreement between all of the ecologists because an

[4] Developed by Luke Verburgth and Sam Laurence, Enviro-Insight.

average of 5 means that each of the ecological disciplines evaluated that particular habitat as being of Very High sensitivity.

The general sensitivity scale as will be shown in subsequent sensitivity and critical habitat mapping is described as follows:

High – Very High (5)

- Low levels of disturbance/transformation
- High fauna species richness and diversity
- Strong presence of Red Listed species and /or SCC
- High forage potential
- Strong connectivity with other important habitats
- High refugia potential
- Relatively high vegetation structural diversity
- Relatively high resilience to environmental impacts
- Relatively high ecosystem uniqueness

Moderate (3-4)

- Relatively moderate levels of disturbance/transformation
- Moderate forage potential
- Moderate fauna species richness and diversity
- Moderate presence of Red Listed species and /or SCC
- Moderate connectivity with other important habitats
- Moderate refugia potential
- Medium levels of vegetation structural diversity
- Relatively moderate resilience to environmental impacts
- Relatively moderate ecosystem uniqueness

Low – Very Low (1-2)

- Relatively high levels of disturbance/transformation
- Low to moderate forage potential
- Low fauna species richness and diversity
- Low presence of Red Listed species and /or SCC
- Low connectivity with other important habitats
- Low refugia potential
- Low levels of vegetation structural diversity
- Relatively low resilience to environmental impacts
- Low levels of ecosystem uniqueness

Further explanation of the criteria is provided below:

- Overall habitat potential: Relates to the ability of a given habitat to support a given fauna species/group.

- Refugia potential: The ability of a given habitat to fulfil shelter and breeding requirements of a given fauna species/group.
- Forage potential: The ability of a given habitat to fulfil food requirements of a given fauna species/group.
- Habitat connectivity: The ability of a given habitat to allow for migratory movement as well as genetic exchange, for a given fauna species/group.
- Overall faunal importance: The relevant importance of the sub-population of a given fauna species/group in the context of the region/country and entire species/group community as a whole. Importance is also related to the conservation status of a given faunal species.

Impact Assessment

The following list of impacts was evaluated mainly based on field observations to identify relevance to the study area. The relevant impacts were then subjected to a prescribed Impact Analysis methodology which is described below. Mitigation measures were only applied to impacts deemed relevant on the basis of the Impact Analysis.

Potential Impacts:

1. Loss and/or displacement of Red List species
2. Loss and/or degradation of threatened ecosystems and vegetation units
3. Loss and/or degradation of natural movement of species (natural corridors etc.)
4. Construction of barriers to animal movement or migration
5. Disturbance of non-resident or migrant species
6. Decrease in biodiversity of natural fauna populations
7. Decrease in availability and reliability of food sources
8. Possibility to introduce and/or enhance the spread of alien species
9. Decrease and/or disturbance to the ecological functioning of natural terrestrial system, mainly due to habitat loss and fragmentation

The Significance of Impacts was assessed in accordance with the following method:

- **Probability** describes the likelihood of the impact actually occurring, and is rated from highly unlikely (1) to definite (5);
- **Severity** of impact includes factors such as duration and intensity of each impact, and is rated from insignificant / ecosystem structure and function unchanged (1) to Disastrous / ecosystem structure and function seriously to critically altered (5);
- **Duration** of impact is rated as short term (2) to permanent (5);
- **Intensity** of impact is rated as natural environment not affected (1) to environment affected to the extent that natural functions are altered to the extent that it will permanently cease or become dysfunctional (5);
- **Sensitivity** of receiving environment is rated as environment not sensitive/important (1) to environment critically sensitive /important (5).

6. FAUNAL HABITATS

Faunal habitats on site are mainly grassland related which some sections disturbed due to alien woody species or transformed (Figure 5). The grassland has some characteristics of the Soweto Highveld Grassland (Figure 6), but is under severe pressure from surrounding land uses including agricultural activities and spreading of alien species. The grassland habitat on site can be considered natural, transformed or infested with alien species (Figure 7). In the north-western corner of the study area the grassland is disturbed due to increased alien species density and abundances which was dominated by *Acacia mearnsii.* In the east of the study area the grassland has been transformed to agricultural land with no indigenous species. Species recorded include *Tagetes minuta, Datura stramonium, Pennisetum clandestinum, Cleome maculata* and a few *Eucalyptus* sp. individuals.

Figure 5: Fauna habitats identified.

Figure 6: Natural grassland habitat.

Figure 7: Disturbed grassland with alien vegetation.

6.1. Overhead Power Line Routes

As mentioned, no survey was undertaken for the two route options for the location of the proposed Overhead Power Line as it falls outside the sampling season, but mainly because a survey for the study site was conducted in April 2017. A general idea of the area and the proposed impacts were noted during the site visit. The Option 1 route runs along an existing dirt road where disturbance is evident. High alien species density and numbers occur along Option 1 with increased edge effects from the surrounding human activities (Figure 8). Alien species include *Acacia* spp., *Eucalyptus* sp., *Tagetes minuta* and *Opuntia* sp. The Option 2 route runs between three pans and over a rocky area which are considered sensitive. The Option 2 route does not seem to be following an existing route, but crosses over several land uses including grassland, alien vegetation and rocky areas (Figure 9). Based on the site visit, Option 1 route is preferred as it will have the lowest impact on the vegetation compared to Option 2.

Figure 8: Option 1 route along dirt road. Grassland has been burnt and alien vegetation such as *Acacia* spp., and *Eucalyptus* sp. occur along the road.

Figure 9: Option 2 route running along rocky areas and grassland.

7. MAMMAL HABITAT ASSESSMENT

Special attention was paid during the evaluation of the qualitative habitat conditions of Red Listed mammal species and SCC considered occurring in or around the study area. Mitigation measures to lessen the impacts and effects of the proposed development were suggested where applicable. The secondary objective of this investigation was to determine which mammals might still reside in and around the study area and to compile a list of expected mammal species.

7.1. Specific Requirements

During the field survey attention was paid to note any signs of potential occurrence of Red Listed species as well as SCC.

These species include (GDARD, 2014):
African Marsh Rat (*Dasymys incomtus*), Spotted-Necked Otter (*Hydrictis maculicollis*), Cape Clawless Otter (*Aonyx capensis*), Highveld Golden Mole (*Amblysomus septentrionalis*), Rough-Haired Golden Mole (*Chrysospalax villosus*), Southern African Hedgehog (*Atelerix frontalis*), White-Tailed Rat (*Mystromys albicaudatus*), and several bat species including Blasius's/Peak-Saddle Horseshoe Bat (*Rhinolophus blasii*), Darling's Horseshoe Bat (*Rhinolophus darlingi*), Geoffrey's Horseshoe Bat (*Rhinolophus clivosus*), Hildebrandt's Horseshoe Bat (*Rhinolophus hildebrandtii*), Natal Long-Fingered Bat (*Miniopterus natalensis*) and Temminck's Hairy Bat (*Myotis tricolor*).

7.2. Results

7.2.1. Mammal habitats identified

The grassland provides suitable habitat for smaller rodents and insectivorous mammals. Species dependent on grass cover and fossorial habitat are likely to occur on site. Furthermore, alien trees such as *Acacia mearnsii* and *Eucalyptus* sp. could support some species with a wide habitat tolerance, but these alien species are not particularly suitable for arboreal species, especially habitat specialists. Based on observations made during the site visit, the proposed study area has been impacted on by increased alien species and habitat loss in the form of agricultural land. A third of the study area is still in a good ecological state with indigenous plant species.

7.2.2. Expected Mammal species

A total of 68 species are expected to occur on the study area (Table 1). It is unlikely that many larger mammals are still prevalent in the study area due habitat loss and fragmentation, although small- to medium-sized mammals are present.

It is expected that numerous small mammals such as Yellow Mongoose (*Cynictis penicillata*), Scrub Hare (*Lepus saxatilis*), Cape Porcupine (*Hystrix africaeaustralis*), Black-backed Jackal (*Canis mesomelas*), Southern Multimammate Mouse (*Mastomys coucha*) and Four-striped Grass Mouse (*Rhabdomys pumilio*) to be present on the study area.

Table 1: Mammal species expected in the study area. Red List species indicated as defined in Child *et al*., (2016).

	Scientific Name	Common Name	Red List Category	Probability of Occurrence
1.	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern	4
2.	*Aepyceros melampus*	Impala	Least Concern	1
3.	*Alcelaphus buselaphus caama*	Red Hartebeest	Least Concern	1
4.	*Antidorcas marsupialis*	Springbok	Least Concern	1
5.	*Connochaetes gnou*	Black Wildebeest	Least Concern	1
6.	*Connochaetes taurinus taurinus*	Blue Wildebeest	Least Concern	1
7.	*Damaliscus pygargus phillipsi*	Blesbok	Least Concern	1
8.	*Kobus ellipsiprymnus*	Waterbuck	Least Concern	1
9.	*Raphicerus campestris*	Steenbok	Least Concern	3
10.	*Sylvicapra grimmia*	Bush/Common Duiker	Least Concern	3
11.	*Tragelaphus oryx*	Common Eland	Least Concern	1
12.	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern	1
13.	*Amblysomus septentrionalis*	Highveld Golden Mole	Near Threatened	1
14.	*Chrysospalax villosus*	Rough-haired Golden mole	Vulnerable	1
15.	*Canis mesomelas*	Black-backed Jackal	Least Concern	4
16.	*Otocyon megalotis*	Bat-eared Fox	Least Concern	4
17.	*Vulpes chama*	Cape Fox	Least Concern	3
18.	*Cercopithecus pygerythrus*	Vervet Monkey	Least Concern	2

	pygerythrus			
19.	*Galago moholi*	Southern Lesser Galago	Least Concern	2
20.	*Papio ursinus*	Chacma Baboon	Least Concern	1
21.	*Taphozous mauritianus*	Mauritian Tomb Bat	Least Concern	2
22.	*Atelerix frontalis*	South African Hedgehog	Near Threatened	4
23.	*Felis nigripes*	Black-footed Cat	Vulnerable	2
24.	*Felis silvestris*	Wild cat	Least Concern	3
25.	*Leptailurus serval*	Serval	Near Threatened	3
26.	*Atilax paludinosus*	Marsh Mongoose	Least Concern	3
27.	*Cynictis penicillata*	Yellow Mongoose	Least Concern	4
28.	*Herpestes sanguineus*	Slender Mongoose	Least Concern	3
29.	*Suricata suricatta*	Suricate (Meerkat)	Least Concern	2
30.	*Parahyaena brunnea*	Brown Hyena	Near Threatened	1
31.	*Cloeotis percivali*	Percival's Short-eared Trident Bat	Endangered	2
32.	*Proteles cristata*	Aardwolf	Least Concern	3
33.	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern	4
34.	*Lepus saxatilis*	Scrub Hare	Least Concern	4
35.	*Elephantulus brachyrhynchus*	Short-snouted Elephant Shrew	Least Concern	3
36.	*Aethomys ineptus*	Tete Veld Rat Aethomys	Least Concern	2
37.	*Gerbilliscus brantsii*	Highveld gerbil	Least Concern	2
38.	*Lemniscomys rosalia*	Single-Striped Mouse	Least Concern	2
39.	*Mastomys coucha*	Southern Multimammate Mouse	Least Concern	4
40.	*Mastomys natalensis*	Natal multimammate mouse	Least Concern	2
41.	*Otomys angoniensis*	Angoni Vlei Rat	Least Concern	3
42.	*Otomys auratus*	Vlei Rat (Grassland type)	Near Threatened	4
43.	*Rhabdomys dilectus*	Mesic Four-striped Mouse	Least Concern	4
44.	*Rhabdomys pumilio*	Four-striped Grass Mouse	Least Concern	4
45.	*Ictonyx striatus*	Striped Polecat	Least Concern	3
46.	*Mellivora capensis*	Honey Badger	Least Concern	3
47.	*Poecilogale albinucha*	African Striped Weasel	Near Threatened	3
48.	*Steatomys* sp.	Fat Mice	Least Concern	3
49.	*Mystromys albicaudatus*	African White-tailed Rat	Vulnerable	3
50.	*Tadarida aegyptiaca*	Egyptian free-tailed bat	Least Concern	2
51.	*Nycteris thebaica*	Egyptian Slit-faced Bat	Least Concern	4
52.	*Orycteropus afer*	Aardvark	Least Concern	2
53.	*Rhinolophus blasii*	Peak-saddle horseshoe bat	Near Threatened	1
54.	*Rhinolophus clivosus*	Geoffroy's horseshoe bat	Least Concern	2
55.	*Rhinolophus darlingi*	Darling's horseshoe bat	Least Concern	2
56.	*Rhinolophus simulator*	Bushveld Horseshoe Bat	Least Concern	1
57.	*Myotis tricolor*	Temminck's hairy bat	Least Concern	2
58.	*Crocidura cyanea*	Reddish-gray Musk Shrew	Least Concern	2

59.	*Crocidura hirta*	Lesser Red Musk Shrew	Least Concern	2
60.	*Suncus infinitesimus*	Least Dwarf Shrew	Least Concern	3
61.	*Xerus inauris*	South African Ground Squirrel	Least Concern	2
62.	*Phacochoerus africanus*	Common Warthog	Least Concern	3
63.	*Neoromicia capensis*	Cape Serotine Bat	Least Concern	3
64.	*Pipistrellus hesperidus*	African Pipistrelle	Least Concern	2
65.	*Pipistrellus rusticus*	Rusty Bat	Least Concern	1
66.	*Scotophilus dinganii*	Yellow-bellied House Bat	Least Concern	2
67.	*Genetta genetta*	Small-spotted Genet	Least Concern	2
68.	*Genetta maculata*	Rusty-spotted Genet	Least Concern	2

The POO of the mammal species listed above are indicated as follows:
Not likely to occur - 1, Low POO - 2, Medium POO - 3, High POO – 4, Confirmed occurrence – 5.

7.2.3. Red List Mammal species and/or SCC

The South African Hedgehog (*Atelerix frontalis*) is a nocturnal species which is mainly found in grassland and savanna vegetation types where ample ground cover for nesting, cover, and insect food sources are available (Skinner & Chimimba, 2005). The species current habitat trend is declining. Agriculture and urbanisation are causing a decrease in available habitat area and quality. Its occurrence in rural, peri-urban and suburban gardens may mitigate declines in natural habitat but this has not been quantified (Light *et al*., 2016). The species has been recorded in the adjacent 2627BB QDS. *A. frontalis* is considered to have a high POO.

The African White-tailed Rat (*Mystromys albicaudatus*) occurs in shrubland and grassland areas. A major requirement of the species is black loam with good vegetation cover (Coetzee & Monadjem, 2008). This species has been recorded in the adjacent 2627BD QDS. The proposed study area has suitable habitat for the species.

The Vlei rat (*Otomys auratus*) prefers cool and wet habitats, usually associated with wetland and marshy areas in the Grassland biome. This species has not been recorded in the 2627BD QDS; however, there is suitable habitat for the species on site.

The African Striped Weasel (*Poecilogale albinucha*) has a wide habitat tolerance and has been recorded from lowland rainforest, semi-desert grassland and pine plantations, but is mainly associated with grassland habitats. The species has not been recorded in the QDS or adjacent QDSs, but is likely to occur on site.

7.3. Findings

The grassland habitat is still in a good ecological condition with minimal impacts and suitable habitat for mammal species. There is suitable habitat on the study area for Red Listed species such as *Atelerix frontalis* and *Otomys auratus*. Connectivity with the surrounding homogenous habitat is not limited. Based on the available information, the study area is considered to have a moderate sensitivity

regarding mammal species. It is suggested that a qualified mammalogist confirm the presence of the mentioned Red List species and/or SCC.

8. HERPETOFAUNA HABITAT ASESSMENT

8.1. Specific Requirements

During the field survey attention was paid to note any signs of potential occurrence of Red Listed species as well as SCC. Red Listed species that might occur on the study area:

- Striped Harlequin Snake (*Homoroselaps dorsalis*)
- Coppery Grass Lizard (*Chamaesaura aenea*)
- Giant bullfrog (*Pyxicephalus adspersus*)

8.2.Results

8.2.1. Herpetofauna habitats identified

The study area provides no conspicuous standing or flowing water bodies as such to provide for the niche preferences for amphibian species (du Preez & Carruthers, 2009) apart from a watercourse a few meters south of the study area. Rocky areas are present on the ridge as well as numerous indigenous tree species for arboreal species. The herbaceous layer, leaf-litter and logs on the ground create suitable habitat for reptiles.

8.2.2. Expected and Herpetofauna species

Based on the impressions gathered during the site visit, atlases (Minter *et al*., 2004; Bates *et al*., 2014), books (Measey, 2011), and databases FrogMAP (continuation of the Southern African Frog Atlas Project) and ReptileMAP (the continuation of the Southern African Reptile Conservation Assessment), expected lists of species which may occur in the study area with their POO were compiled. Seventeen amphibian species and 31 reptile species have previously been recorded within the 2627BA QDS (Tables 2 and 3);

Table 2: Amphibian species (both scientific and common names) inferred to occupy the study area. Taxonomy and Red List rankings of species follow IUCN classifications (IUCN, 2016). Red List species are indicated in red.

	Scientific Name	Common Name	Red List Category	Probability of Occurrence
1.	*Breviceps adspersus adspersus*	Bushveld Rain Frog	Least Concern	3
2.	*Schismaderma carens*	Red Toad	Least Concern	3
3.	*Sclerophrys capensis*	Raucous Toad	Least Concern	3
4.	*Sclerophrys garmani*	Olive Toad	Least Concern	2
5.	*Sclerophrys gutturalis*	Guttural Toad	Least Concern	3
6.	*Kassina senegalensis*	Bubbling Kassina	Least Concern	3
7.	*Phrynomantis bifasciatus*	Banded Rubber Frog	Least Concern	2

8.	*Phrynobatrachus natalensis*	Snoring Puddle Frog	Least Concern	3
9.	*Xenopus laevis*	Common Platanna	Least Concern	2
10.	*Amietia delalandii*	Delalande's River Frog	Least Concern	2
11.	*Amietia fuscigula*	Cape River Frog	Least Concern	2
12.	*Amietia quecketti*	Common River Frog	Least Concern	2
13.	*Cacosternum boettgeri*	Common Caco	Least Concern	4
14.	*Pyxicephalus adspersus*	Giant Bull Frog	Near Threatened*	1
15.	*Strongylopus fasciatus*	Striped Stream Frog	Least Concern	2
16.	*Tomopterna cryptotis*	Tremolo Sand Frog	Least Concern	4
17.	*Tomopterna natalensis*	Natal Sand Frog	Least Concern	4

The POO of amphibian species listed above are indicated as follows:
Not likely to occur - 1, Low POO - 2, Medium POO - 3, High POO – 4, Confirmed occurrence – 5.

Table 3: Reptile species (both scientific and common names) inferred to occupy the study area. Taxonomy and Red List rankings (indicated in red) of species as defined by Bates *et al*. (2014).

	Scientific Name	**Common Name**	**Red List Category**	**Occurrence Probability**
1.	*Agama aculeata distanti*	Distant's Ground Agama	Least Concern	4
2.	*Agama atra*	Southern Rock Agama	Least Concern	1
3.	*Chamaeleo dilepis dilepis*	Common Flap-neck Chameleon	Least Concern	1
4.	*Crotaphopeltis hotamboeia*	Red-lipped Snake	Least Concern	3
5.	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern	4
6.	*Dispholidus typus typus*	Boomslang	Least Concern	2
7.	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake	Least Concern	2
8.	*Chamaesaura aenea*	Coppery Grass Lizard	Near Threatened	3
9.	*Pseudocordylus melanotus melanotus*	Common Crag Lizard	Least Concern	1
10.	*Cordylus vittifer*	Common Girdled Lizard	Least Concern	1
11.	*Elapsoidea sundevallii media*	Highveld Garter Snake	Least Concern	2
12.	*Hemachatus haemachatus*	Rinkhals	Least Concern	4
13.	*Lygodactylus capensis capensis*	Common Dwarf Gecko	Least Concern	4
14.	*Pachydactylus affinis*	Transvaal Gecko	Least Concern	4
15.	*Pachydactylus capensis*	Cape Gecko	Least Concern	4
16.	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Least Concern	2
17.	*Aparallactus capensis*	Black-headed Centipede-eater	Least Concern	3
18.	*Atractaspis bibronii*	Bibron's Stiletto Snake	Least Concern	3
19.	*Boaedon capensis*	Common House Snake	Least Concern	4
20.	*Homoroselaps dorsalis*	Striped Harlequin Snake	Near Threatened	2
21.	*Homoroselaps lacteus*	Spotted Harlequin Snake	Least Concern	3
22.	*Lamprophis aurora*	Aurora House Snake	Least Concern	4
23.	*Lycodonomorphus inornatus*	Olive House Snake	Least Concern	2
24.	*Lycodonomorphus rufulus*	Brown Water Snake	Least Concern	3
25.	*Lycophidion capense capense*	Cape Wolf Snake	Least Concern	4

26.	*Prosymna sundevallii*	Sundevall's Shovel-snout	Least Concern	3
27.	*Psammophis brevirostris*	Short-snouted Grass Snake	Least Concern	3
28.	*Psammophis crucifer*	Cross-marked Grass Snake	Least Concern	3
29.	*Psammophylax rhombeatus rhombeatus*	Spotted Grass Snake	Least Concern	4
30.	*Psammophylax tritaeniatus*	Striped Grass Snake	Least Concern	3
31.	*Python natalensis*	Southern African Python	Least Concern	2
32.	*Pseudaspis cana*	Mole Snake	Least Concern	3
33.	*Leptotyphlops scutifrons conjunctus*	Eastern Thread Snake	Least Concern	3
34.	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	Least Concern	2
35.	*Pelomedusa subrufa*	Marsh Terrapin	Least Concern	3
36.	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	Least Concern	4
37.	*Trachylepis capensis*	Cape Skink	Least Concern	3
38.	*Trachylepis punctatissima*	Speckled Rock Skink	Least Concern	2
39.	*Trachylepis varia*	Variable Skink	Least Concern	3
40.	*Kinixys lobatsiana*	Lobatse Hinged Tortoise	Least Concern	2
41.	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern	2
42.	*Afrotyphlops bibronii*	Bibron's Blind Snake	Least Concern	2
43.	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern	3
44.	*Bitis arietans arietans*	Puff Adder	Least Concern	2
45.	*Causus rhombeatus*	Rhombic Night Adder	Least Concern	3

*The POO of the reptile species listed above are indicated as follows:
Not likely to occur - 1, Low POO - 2, Medium POO - 3, High POO – 4, Confirmed occurrence – 5.

8.2.3. Red List Herpetofauna species and/or SCC

The Striped Harlequin Snake (*Homoroselaps dorsalis*) is a very rare species and infrequently recorded during surveys (about only 12 recorded for Gauteng). It is a cryptic species which lives mostly underground or in dead termitaria, which makes it extremely difficult to confirm. The species has not been recorded in the 2627BD QDS or any adjacent QDS (ADU, 2017). The closest recorded is from the 2628AC QDS, approximately 55km from the study area. Based on the available information, it is unlikely that this species will be present on the proposed development site.

The Coppery Grass Lizard (*Chamaesaura aenea*) is restricted to the Grassland biome. It is found on grassy slopes and plateau of the eastern escarpment and Highveld, where it probably shelters in the base of grass tussocks (Bates *et al*., 2014). It is not a listed species according to Gauteng's Conservation Plan (GDARD, 2014). The species has not been recorded in the 2627BD QDS or any adjacent QDS according to the virtual museum records (ADU, 2017). It has, however, been recorded in the 2627BD QDS according to Bates *et al*., (2014). The species has a medium likelihood to occur on site.

The Giant bullfrog (*Pyxicephalus adspersus*) has been recorded in the 2627BA QDS (FrogMap, 2017) in which the study area resides as well as in the adjacent 2627BB and 2627DB QDSs. Due to their ecological attributes (large amphibians which breed in seasonally inundated wetlands) it is unlikely for this species

to occur on the study area. If the wetland and its associated buffer zone are protected, it is likely that the habitat for *Pyxicephalus adspersus* will also be protected. This species was considered of conservation importance and categorised as Near Threatened according to the NEMBA ToPS List (SANBI, 2013). However, recent research has indicated that it is more numerous than originally thought and it has subsequently been down-listed (GDARD, 2014). Accordingly, GDARD has removed Giant Bullfrog from the list of trigger species.

8.3. Findings

The grassland habitat is still in a good ecological condition with minimal impacts. Alien tree species such as *Acacia mearnsii* and *Eucalyptus* sp. could provide habitat for arboreal herpetofauna species, but it is not considered optimal habitat. Limited suitable habitat for any Red Listed herpetofauna species and/or SCC such as the *C. aenea, P. adspersus* and *H. dorsalis* are present on the study area. Based on the available information, the study area is considered to have a moderate to low sensitivity regarding herpetofauna species. The absence of the Red Listed species and/or SCC from the QDS does not necessarily mean that they are not present on the study area, but could be an indication of under sampling in the larger area.

9. INVERTEBRATE HABITAT ASSESSMENT

9.1. Specific Requirements

During the site visit attention was paid to note any signs of potential occurrence of Red List species.

These species include (prioritised by GDARD):

- Roodepoort Copper Butterfly (*Aloeides dentatis* subsp. *dentatis*)
- Highveld Golden Opal Butterfly (= Heidelberg Copper) (*Chrysoritis aureus*)
- Stobbia's Fruit Chafer Beetle (*Ichnestoma stobbiai*)
- Highveld Blue Butterfly (*Lepidochrysops praeterita*).

Roodepoort Copper Butterfly (*Aloeides dentatis* subsp. *dentatis*):

This butterfly is proposed for Endangered (Henning *et al*., 2009) and Mecenero *et al.* (2013), based on its limited distribution and possible decline in quality and extent of remaining habitats. Suitable habitat around known localities was mapped off satellite imagery. A 100 % target was set for these areas, though it is worth noting that the entire area is within existing Protected Areas, and hence does not influence the outcome of the Gauteng C-Plan v3.3 (2014).

This species is typically found in Carletonville Dolomite Grassland at an elevation of 1 500 to 1 900 m. The species is only known from Ruimsig (Roodepoort), Heidelberg (Suikerbosrand – from two localities) and Klipriviersberg. The species has a range of approximately 70 km^2. All known localities of this species occur in reserves; however the threat of habitat modification due to environmental changes remains

(Henning *et al*., 2009). It was established that the butterfly prefers a disturbed community in a pioneer or early stage of succession, as exhibited by the pioneer plant species in the community. In addition, the vegetation controls the distribution of the host ant (*Lepisiota capensis*) and the presence of the ant is a prerequisite for the butterfly to breed (Henning *et al*., 2009)

The larval food plant of this species at Ruimsig Reserve is *Hermannia depressa* and at Suikerbosrand *Lotononis eriantha*. The presence of the food plant alone will not ensure the presence of the butterfly (Henning *et al*., 2009). Population control of this butterfly species probably takes place owing to finite facilities in *Lepisiota* ant nests. Males are strongly territorial and need open patches as territorial sites (Henning *et al*., 2009).

Highveld Golden Opal (*Chrysoritis aureus*) (= Heidelberg Copper):

This butterfly is proposed to be listed as Vulnerable by (Henning *et al*., 2009) and being upgraded to Endangered by Mecenero *et al.,* (2013). Highveld Golden Opal is host plant (*Clutia pulchella* for larvae) and host ant (*Crematogaster* species) specific, and known from a handful of localities on the Heidelberg-Balfour-Greylingstad ridge system (Terblanche & van Hamburg, 2003; Henning *et al*., 2009). The habitat structure of these localities is similar as a tree stratum is absent. It is currently protected in the Alice Glockner Nature Reserve, the Suikerbosrand Nature Reserve and in National Heritage Site No. 14 (Terblanche & van Hamburg, 2003; Henning *et al*., 2009). Its lack of flexibility renders *C. aureus* highly sensitive to any disturbance in its habitat.

The habitat preference of this species is on south-facing, well-drained slopes with shallow humus in the two vegetation types Andesite Mountain Bushveld and Gold Reef Mountain Bushveld, belonging to the Central Bushveld Bioregion of the Savanna Biome (Mucina & Rutherford, 2006). Frost and fire may both be important ecological factors that sustain a suitable habitat for *Chrysoritis aureus* (Terblanche *et al*., 2003).

It is possible that the species is under-recorded. Known localities were buffered by 500m and the full extent of this area was included as a target. Modelling for the species was based on SABCA atlas and data from site visits, and this resulted in the development of a model which reflected the high altitude ridge systems which host the species.

Stobbia's Fruit Chafer Beetle (*Ichnestoma stobbiai*):

Although not listed, it appears that this species of beetle would qualify as Vulnerable under the IUCN Red List criteria. An expert driven mapping approach was used for the species to map the area likely to be occupied by the beetle at known localities. All suitable, untransformed habitats in the vicinity of known records were mapped as suitable, occupied habitat for the species. No attempt was made to predict the occurrence of additional populations in other areas. A 100% of the confirmed habitat and the extended mapped suitable habitat were targeted.

This species in particular only occur in small fragments in pristine grassland along the Transvaal Magaliesberg system. This rare Fruit Chafer Beetle is mostly endemic to Gauteng Province, with a single population occurring in the adjacent parts of North West Province (Kruger& Scholtz, 2008).

Highveld Blue Butterfly (*Lepidochrysops praeterita*):

Although the species is classified as Vulnerable, it is proposed for Endangered (Henning *et al*., 2009), based on a limited distribution and the extent of mining and agricultural activities within its range. It is largely endemic to Gauteng, specifically in the Carletonville area, but extends into the Potchefstroom area in the North West and Sasolburg in the Free State. No conservation measures are in place (Henning *et al*., 2009). The species is found on a few koppies and rocky hillsides between Potchefstroom area in the North West and Sasolburg in the Free State.

Known localities were buffered by 500m and the full extent of this area was included as a target. Modelling for the species was based on South African Butterfly Conservation Assessment (SABCA) atlas and data from site visits. The model refined the basic distribution by incorporating slope and aspect, and removed unsuitable land cover classes and areas smaller than the smallest known patch of habitat occupied by the species.

The vegetation types where this species have been recorded are the Soweto Highveld Grassland and Rand Highveld Grassland in the Mesic Highveld Grassland Bioregion of the Grassland Biome (described in Mucina & Rutherford, 2006). The larval food plant of this species is *Ocimum obovatum.*

9.2. Results

9.2.1. Invertebrate habitats identified

The ridge and grassland habitats could support numerous invertebrate species, including Red List species.

9.2.2. Probability of Occurrence of prioritised Threatened Invertebrate species.

The POO of the four Red List species prioritised for Gauteng as well as one SCC are indicated in Table 4. Based on the available habitat, it is unlikely for any of these species to occur on the study area.

Table 4: Threatened invertebrate species probability of occurrence.

	Scientific Name	**Common name**	**Red List Category**	**Probability of Occurrence**
1.	*Aloeides dentatis* subsp. *dentatis*	Roodepoort Copper Butterfly	Endangered	1
2.	*Chrysoritis aureus*	Heidelberg Copper Butterfly	Endangered	1
3.	*Ichnestoma stobbiai*	Stobbia's Fruit Chafer Beetle	Vulnerable	1
4.	*Lepidochrysops praeterita*	Highveld Blue Butterfly	Endangered	1

The POO of the invertebrates species listed above is indicated as follows:

Not likely to occur - 1, Low POO - 2, Medium POO - 3, High POO – 4, Confirmed occurrence – 5.

9.2.3. Red List Invertebrate species and/or SCC

Highveld Blue Butterfly (*Lepidochrysops praeterita*) has been recorded in the adjacent 2627BD, 2627AD and 2627BC QDSs located towards the west, preferring koppies and rocky hillsides. The occurrence of this species on the study area is unlikely based on its preferred habitat and current distribution. It is therefore recommended, unless GDARD deem it necessary for additional studies, that no further action is required.

9.3.Findings

No Red List invertebrate species or SCC is expected to occur on the study area. *Lepidochrysops praeterita* has been recorded in the adjacent QDSs towards the west, but is unlikely to occur on site due to its preferred habitat. The study area is not considered ecologically sensitive with regards to invertebrates.

10. OVERALL FINDINGS AND IMPLICATIONS

The study area is situated in the threatened Soweto Highveld Grassland and in an Ecological Support Area. It consists of the grassland habitat as well as disturbed and transformed areas. The site has suitable habitat for several Red Listed fauna species and/or SCC, including the South African Hedgehog (*Atelerix frontalis*), Vlei rat (*Otomys auratus*) and Coppery Grass Lizard (*Chamaesaura aenea*). It is unlikely for the Highveld Blue Butterfly (*Lepidochrysops praeterita*) to occur on site. Should any of these Red Listed species be found on site, the necessary mitigation measures should be implemented (*refer to section 12 below*). A third of the study area is considered to have a moderate conservation importance and ecological sensitivity pertaining to fauna species (Figure 10).

The Overhead Power Lines are not likely to affect fauna species movement or cause extensive habitat loss for utilisation by fauna species. Accordingly, from a fauna perspective assessed in this report (excluding avifauna), impacts of both routes are considered to be low. From a habitat perspective, Option 1 route is preferred as it causes less habitat loss and fragmentation.

Figure 10: Sensitivity map of the study site.

11. ENVIRONMENTAL IMPACT ASSESSMENT

The following Impact ratings are shown in relation to the mapped areas of sensitivity and are subject to avoidance (buffering) mitigation measures. The primary mitigation measures are in relation to buffering and are described in further detail below.

	Pre-mitigation						Post-mitigation					
Impact	Duration of Impact	Spatial Scope	Sensitivity of Receiving Environment	Severity of Impact	Probability of Impact	Significance	Duration of Impact	Spatial Scope	Sensitivity of Receiving Environment	Severity of Impact	Probability of Impact	Significance
Impact on natural movement and foraging of species	Long term	Regional	Ecology moderately sensitive /important	Significant / ecosystem structure and function altered	Probable	Moderate	Short-term	Development Specific	Moderate / ecosystem structure and function slightly unchanged	Low Significance	Possible	Low
Invasion of alien fauna	Long term	Regional	Ecology moderately sensitive /important	Significant / ecosystem structure and function altered	Likely	Moderate	Short-term	Development Specific	Moderate / ecosystem structure and function slightly unchanged	Low Significance	Possible	Low
Construction of barriers to animal movement or migration	Permanent	Regional	Significant/ ecosystem structure and function moderately altered	Significant / ecosystem structure and function altered	Probable	Moderate	Long term	Local Area	Moderate / ecosystem structure and function slightly unchanged	Low Significance	Possible	Low

Loss of threatened IUCN and National threatened faunal species	Permanent	Regional	Ecology moderately sensitive /important	Moderate to High Significance/ Ecologically Important	Possible	Moderate to High	Long term	Local Area	Harmful / ecosystem structure and function altered	Moderate to Low Significance	Likely	Moderate to low
Trapping or killing of fauna species	Short term	Local area	Ecology moderately sensitive /important	High Significance	Possible	High	Short term	Local Area	Moderate / ecosystem structure and function slightly unchanged	Low Significance	Possible	Low
Vegetation and top soil clearing, i.e. habitat loss	Short term	Local area	Ecology moderately sensitive /important	Moderate Significance/ Ecologically Important	Probable	High	Short term	Local Area	Moderate / ecosystem structure and function slightly unchanged	Moderate to Low Significance	Likely	Moderate

12. RECOMMENDATIONS AND MITIGATION MEASURES

Should the proposed development be approved, the following is recommended:

- An appropriate management authority should be identified that must be contractually bound to implement the Environmental Management Programme (EMPr) and Record of Decision (ROD) during the operational phase of the development and be informed of their responsibilities in terms of the EMPr and ROD.
- The EMPr should comply with the *Minimum Requirements for Ecological Management Plans* according to GDARD.
- Induction should be done for all civil contractors and for each building contractor prior to them commencing on the study area.
- Prior to the commencement of construction activities' initial clearing of all alien vegetation should take place.
- The contractor must ensure that no faunal species are trapped, killed or in any way disturbed during the constructional phase.
- All construction activities must be restricted to the demarcated areas to ensure no disturbance of the surrounding area.
- It is suggested that a mammalian specialist confirm the presence of the mentioned Red List species on site prior to construction on site.
- To ensure minimal disturbance of faunal habitat it is recommended that construction should take place during winter, outside the reproductive season of the species present on the study area.
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that fauna present on the study area have enough time to relocate.
- The site should also be inspected for burrows and signs of recent animal activity. If found, these burrows must be excavated and animals found should be relocated to a safe place before any construction or clearing. A specialist in the zoological field should be contacted with regards to this.
- Outside lighting should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.
- All concrete and cement works be restricted to areas of low ecological sensitivity, away from watercourses and its associated buffers, defined on site and clearly demarcated. Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna.
- Suitable terrestrial corridors should be incorporated to facilitate safe movement of fauna species from the site to the surrounding natural areas. Fences should ensure free movement of small mammals and herpetofauna species, accordingly brick walls (obstructions of any form) should be avoided.

- Although not assessed in this report, anti-collision devices such as bird flappers should be installed on powerlines.

13. CONCLUSION

The proposed development is likely to have an overall low impact concerning the fauna of the study area should appropriate mitigation measures be followed. Habitat loss is of concern as a third of the study area is considered moderately sensitive from a faunal perspective. Option 1 route of the Overhead Power Line is preferred as it will have the lowest impact on the environment, i.e. low habitat loss and fragmentation. It is suggested that a mammalian specialist confirm the presence of the mentioned Red List species on site, as there is suitable habitat. The above-mentioned recommendations should be included in an Environmental Management Programme, and should be implemented by an Environmental Control Officer. Construction should have minimal negative impacts on the biodiversity patterns of fauna species mentioned in this report.

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APPENDIX E5

AVIFAUNAL REVIEW

Wheatlands Solar Photovoltaic Facility

Avifaunal review

29 August 2017

1. Introduction

This project consists of a Solar Photovoltaic facility in Wheatlands west of Randfontein. This project is starting with a Basic Assessment currently. SOLARRESERVE appointed WildSkies Ecological Services to review the work done to date and avifaunal risks at the site. SOLARRESERVE informed WildSkies that the listed activities applied for include:

Listing Notice 1 Activity 1, 11, 14, 27, 56
Listing Notice 3 Activity 4, 12, 18

We received the following information from SOLARRESERVE:

1. KMZ file of site outline
2. Fauna Habitat Assessment (Bokamoso 2017)
3. Pdf map of project layout
4. Jpeg map of site outline and grid connection (see Figure 1)
5. Wheatlands Project Description

Figure 1. Site outline & route of grid connection.

The project will consist of the following:

- The Wheatlands site is proposed to include several arrays of PV solar panels (31,200) as well as utility scale integrated flow batteries with a combined export capacity limit of 9.320 MWac.
- The project will be constructed on a smaller, 19.9773ha portion “leased area” cut out of the Wheatlands farm
- The facility will consist of approximately 16ha of PV panels (comprising of the photovoltaic modules/panels, mounting structures and associated balance of system (tracking/fixed hardware, protection systems i.e. masts and electronica and battery plant) and battery storage (Vanadium flow batteries housed in 40 ft. containers consisting of cell stacks and vanadium electrolyte contained in tanks with all associated balance of plant (piping, pumps, and control equipment).
- Associated infrastructure including Inverters, transformers and switchgear with battery storage; An on-site substation consisting of a 40ft container split with Project and Randfontein equipment in each respective section of the substation.
- 11kV combination of cable and OHL 12/13m high from Wheatland’s site substation to Drowell substation connecting into Randfontein’s 11KV (approximately 7km in length);
- Cabling between the project components;
- Prefabricated housing for administration offices, security and guard houses, maintenance and storage;

- Temporary man-camp; Temporary laydown areas;
- Raw water tank; Project primary and/or secondary access road/s, associated access point/s, internal distribution roads and crossings; and
- Fencing and perimeter security system around the project development footprint, and all other necessary related infrastructure.

2. Methods

We reviewed the available documentation to assess the risk to avifauna at the site. In addition to the information supplied by SOLARRESERVE, we consulted; the First and Second Southern African Bird Atlas Projects data for the area (www.mybirdpatch.adu.org.za); the Important Bird & Biodiversity Area data (Marnewick *et al,* 2015); Google Earth imagery; the "GDARD requirements for Biodiversity Assessments Version 3"; and the 2017 "Birds & Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa" by BirdLife South Africa.

3. Findings

Key findings of the Faunal Habitat Assessment (Bokamoso 2017) relevant to avifauna are as follows:

- Site falls in Soweto Highveld Grassland vegetation type, a Vulnerable vegetation type.
- Site falls partially in an "Ecological Support Area" and partially in an "Important Area" (Gauteng Conservation Plan 'C-Plan' v3.3 -2014). ESAs are required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas.
- Site is under severe pressure from surrounding land use.
- Of the 19.7ha site assessed by Bokamoso, 8.1ha is transformed for agriculture; 4.5ha is disturbed grassland; and 7ha is grassland.
- Site classified as low and medium sensitivity for fauna.
- Avifauna was not considered by this assessment.

Our own desktop based findings are as follows:

- The proposed site is not in an Important Bird & Biodiversity Area (Marnewick *et al*, 2015), the closest being approximately 13km North of site.
- The power line grid connection route will pass through an "Irreplaceable Area" (C-Plan 2014).

- Approximately 305 bird species have been recorded in the broader area within which this site is located by the First and Second Southern African Bird Atlas Project www.mybirdpatch.adu.org.za). Of these 16 species are Red Listed. This does not mean that all these species utilise the proposed site, but they could possibly occur there if conditions are right.
- Our own judgement is that the following Red Listed species could possibly occur on the site: African Grass-Owl *Tyto capensis*; Lanner Falcon *Falco biarmicus*; and White-bellied Korhaan *Eupodotis senegalensis.* The African Grass-Owl could utilise the small section of wetland on the southern boundary of the site or the multiple pans (and surrounding grassland) along the grid connection route. The White-bellied Korhaan and Lanner Falcon could utilise the untransformed grassland on site.
- Although this review is not a full specialist study we feel it important for the project to comply with the "GDARD requirements for Biodiversity Assessments Version 3" which state:
    - "The SOC (Specialist Ornithological Consultant) must determine whether the proposed development site falls within the known or expected distribution of any of the following Red List bird species prioritized by GDARD:- Cape Vulture, Blue Crane, Lesser Kestrel, African Grass-Owl, African Marsh-Harrier, White-backed Night-Heron, White-bellied Korhaan, Martial Eagle, African Finfoot, Lesser Flamingo, Secretarybird, Black Stork, Half-collared Kingfisher and Greater Flamingo.
    - The SOC must determine whether suitable habitat occurs on the proposed development site or neighbouring properties for those priority Red List species whose distribution overlaps with the proposed development site.
    - Where distribution and habitat availability suggest a high probability of one or more priority Red List bird species occurring on site, the SOC must map suitable habitat (see *Sensitivity Mapping rules for Biodiversity Assessments* (spatial rules for birds) and indicate the number of individuals/pairs that could potentially be supported, given that it is unlikely that all birds will be located during a limited survey.
- Given that we believe there is a likelihood of two of these priority species occurring on site (African Grass-Owl & White-bellied Korhaan), we recommend that a full avifaunal specialist study be conducted with specific reference to these two species.
- The BirdLife SA Guidelines state: "These guidelines are aimed at all SEFs that require environmental authorisation for electricity generation. These guidelines are not intended for small-scale, distributed solar facilities." Reading this in conjunction with the information in Section 1 that environmental authorisation for the proposed solar generation has been applied for, we conclude that this project does need to comply with the BirdLife Guidelines.

4. Conclusion

We recommend that an avifaunal specialist study be conducted for this site (including the grid connection route), with particular emphasis on African Grass-Owl and White-bellied Korhaan. The terms of reference for this study should include compliance with all provisions of the "GDARD requirements for Biodiversity Assessments Version 3" and the 2017 "Birds & Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern Africa" by BirdLife South Africa.

Our interpretation of the BirdLife guidelines is that the proposed site would be classified as Small and Low sensitivity and therefore qualify for "Regime 1" monitoring as described below:

"For assessment regime 1, the consulting avian specialist should visit the development site at least once and spend sufficient time there to obtain first-hand knowledge of the avian habitats present, in order to predict the affected avifauna, the nature and scale of possible impacts and the best mitigation options available. This assessment should be informed substantially by the specialist's previous experience of similar habitats and bird taxa, supplemented by the existing data describing the birds likely to be present (e.g. SABAP 1 and 2 data). The specialist should endeavour to see as much of the inclusive affected area as possible, and any field data collected on site should also be used in the assessment. If there is reason to suspect an obvious and predictable seasonal peak in avian abundance or activity in the general area of the proposed development, the site visit must be timed to coincide with this peak time (e.g. soon after rain which prompts influxes of birds into dry areas, or in summer when the majority of migratory birds would be present). All other factors aside, the time spent on site should be greater in instances where the existing bird data are few. Beyond these simple but important requirements, the scope of work done on site for lower risk project is largely at the discretion of the consulting specialist."

5. References

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APPENDIX E6

WETLAND REPORT

The Proposed Wheatlands Solar Farm

Wetland Report

September 2017

Drafted by:

Lizette Delport

Bokamoso Landscape Architects and Environmental Consultants cc

Prepared for:

Solar Reserve South Africa Management (Pty) Ltd

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Declaration of Independence

I, **Lizette Delport**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent specialist and will perform the study in an objective manner free of influence and prejudice, even if the resultant findings are unfavourable to the applicant;
- Have the relevant expertise in conducting the report relevant to this application;
- Will comply with all regulations, Acts and other applicable guidelines that are applicable to the activity;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Do not have any conflicting interests in the preparation of this report;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision taken with respect to the application by the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions (SACNASP), will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

This report has been prepared according to the requirements of Appendix 6 of the Environmental Impact Assessments Regulations Amendment, 2017 (GNR 326).

Lizette Delport (*Cand.Sci.Nat.*)
Wetland specialist
SACNASP Reg. No. 100144/15

Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Therefore the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although the author exercised due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

Disclaimer

This report is aimed at evaluating site specific conditions as determined in context of relevant legislation and guidelines and to ensure the conservation and management of the water resources found on the site. However, the intention of this study is not to function as one of several attempts made by the proponent in order to gain favourable outcomes for the application. Rather, this report functions as an independent study and not as a comparative study between wetland specialists.

This report may be submitted directly to the competent authority should a prolonged correspondence occur between specialists and the applicant due to delineation comparisons.

Specialists	
Field work, data analysis and report writing	Lizette Delport BSc Hons (Environmental Management) MSc (Aquatic Health) Environmental Scientist / Wetland Specialist SACNASP Reg. No. 100144/15
Report Review	Antoinette Bootsma MSc Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222/09

EXECUTIVE SUMMARY

Bokamoso Landscape and Environmental Consultants cc, Specialist Division, was appointed by Solar Reserve South Africa Management (Pty) Ltd. to conduct a wetland delineation and functional assessment for the proposed Wheatlands Solar Farm and associated powerlines situated on the remaining Extent of the Farm Wheatlands 260 IQ, Gauteng. The Solar Farm site covers an area of approximately 20 hectares. Two options for 11kV overhead powerlines that run from the Solar Farm to a substation in the north-east are proposed.

A site visit was conducted on 4 April, 2017 and a follow up survey on 29 August, 2017.

The terms of reference for the current study were as follows:

- Delineate the wetland areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake strategical functional assessment of wetlands areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss potential impacts, mitigation and management procedures relevant to conserving wetland areas on the site.
- Perform a risk assessment to determine if the proposed development requires a water use licence.

Four wetlands were found to occur within 500m of the study site, a valley bottom with a channel and three pans. One wetland was found approximately 180m to the west of the Solar Farm site and is classified as a valley bottom with a channel (non-perennial stream).Vegetation in the surrounding area was mostly uniform with *Eragrostis curvula* and *Monocymbium ceresiforme* dominating the landscape, whereas water-loving species within the wetland were *Cyperacea* and *Paspalum dilatatum* forming dense basal cover. Bankrotbos (*Seriphium plumosum*) grows in scattered stands throughout the area adjacent to the wetland.

Three depression wetlands/pans occur in the study area within 500m of the proposed powerline alignments. The pans were delineated during the dry season (August) and therefore vegetation species could not be accurately identified. However, a definite vegetation growth transition was identifiable between the temporary and seasonal zones and mottling was identifiable within the top 50cm of soil.

The valley bottom wetland has been impacted predominantly due to invasive plant growth and some trampling by cattle. Water has been dammed both upstream and downstream of the study site.

The combined **PES** score for the valley bottom wetland area is **2.5** and **C - Moderately modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. The expected trajectory of change is to remain stable should no further impacts occur on the wetland.

The **EIS** scores indicate that the study site is classed as **High** – the wetland is considered to be ecologically important and sensitive. The potential for direct human benefits is low, whereas the dense vegetation growth aids in sediment and pollutant trapping. The presence of small dams at regular intervals allows for the intermittent trapping of sediment and toxicants as water flows further downstream. The wetland is expected to be sensitive to habitat modifications from surrounding land use.

Pan 1 and Pan 2 showed almost identical characteristics and impacts and therefore are discussed together. The presence of water in the central portion of the pan is ideal for hydrophytic vegetation. Although vegetation growth was robust and most likely of wetland types, the species could not be confirmed due to the survey taking place during the dry season. Impacts on the pans include burning and grazing of livestock. Alien trees (such as the bluegum) are present in the upper catchments, but do not appear to have an identifiable effect on the wetland hydrology. A marsh owl was spotted in Pan 2 which is an indication of the value of the wetland as a habitat for fauna.

The combined **PES** score for Pan 1 and 2 are **0.93** and **A/B - Largely natural with few modifications.** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place. The expected trajectory of change is to remain stable should no further impacts occur on the wetland.

The **EIS** scores indicate that the study site is classed as **Moderate** – The wetlands are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications, however they do provide habitat for various faunal species.

Pan 3 is a large wetland with robust and varied hydrophytic vegetation growth. The wetland integrity has been impacted by tracks and roads which appear to be designed for 4x4 vehicle use. Hills and depressions have been created for these tracks which alter the water flow and lead to pooling in parts of the pan. Birdlife is abundant in the wetland and the thick vegetation growth provides nesting and feeding areas for species such as geese, sacred ibis, cattle egret etc.

The combined **PES** score for the wetland area is **1.4** and **B – Largely natural with few modifications.** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place. The expected trajectory of change is to remain stable should no further impacts occur on the wetland.

The **EIS** scores indicate that the study site is classed as **High** – the wetland is considered to be ecologically important and sensitive. The potential for direct human benefits is low, whereas the dense vegetation growth aids in sediment and pollutant trapping. A variety of habitats are present for various bird species and small mammals. The wetland is expected to be sensitive to habitat modifications from surrounding land use.

Table A: PES scores for the wetlands within 500m of the proposed Wheatlands Solar Farm

		Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
Valley bottom wetland	Area weighted impact scores	4.0		1.4		2.2	
	PES Category	**D**	→	**B**	→	**C**	→
Pan 1	Area weighted impact scores	**1.0**		**0.0**		**1.8**	
	PES Category	**B**	→	**A**	→	**B**	→
Pan 2	Area weighted impact scores	**1.0**		**0.0**		**1.8**	
	PES Category	**B**	→	**A**	→	**B**	→
Pan 3	Area weighted impact scores	**2.0**		**0.4**		**1.8**	
	PES Category	**B/C**	↓	**A**	→	**C**	→

Table B: EIS scores for the wetlands within 500m of the proposed Wheatlands Solar Farm

	EIS	Confidence
Valley bottom wetland	1.8	4.0
Pan 1	1.8	4.0
Pan 2	1.8	4.0
Pan 3	2.0	4.0

A **50m** buffer for wetlands outside of the the urban zone are required by GDARD (2014) though the development will have minimal effect on the valley bottom wetland condition since the western outline of the Solar Farm site is found more than 180m from the wetland and the Solar Farm will not require any crossings or activites within this area. For the power lines, the footprint is small and therefore the impact is expected to be low with effective mitigation measures being in place. A **17m** buffer has been determinded for the site using the buffer tool (MacFarlane et al, 2014).

The distance from the Wheatlands Solar Farm to the valley bottom wetland is greater than 180m and no power lines are planned to cross any wetlands, therefrore the impacts from the development are expected to be low. A comparison of the powerline alignment options indicates the following:

- Both powerline alignment options cross irreplaceable areas and ecological support areas.

- Option 1 covers a shorter distance along existing roads which will lower construction costs and time. The entire route follows existing roads throughout and is within 500m but further than 200m of Pan 1 and along the outer catchment edge of Pan 3.
- Option 2 crosses a greater part of the catchment and outer edges of Pan 3. The option covers a larger distance through irreplaceable and ecological support areas and is within 500m of all pans.

Based on this assessment, Option 1 is the preferred alignment from a wetland point of view. An environmental management plan and stormwater management plan must be developed to prevent and mitigate any impacts that may occur on the wetlands from the proposed development.

Risks and impacts on watercourses are not notable and do not require mitigation measures on a higher level, which costs more and requires specialist input. In terms of section 22 of the National Water Act (36 of 1998) (NWA), a section 21 (c) and (i) water use license is not required.

The proposed Wheatlands Solar Farm is expected to have low to no impact on nearby watercourses and therefore the project is approved from a wetland perspective.

Table of Contents

Figures

Tables

1 INTRODUCTION

Bokamoso Landscape and Environmental Consultants cc, Specialist Division, was appointed by Solar Reserve South Africa Management (Pty) Ltd. to conduct a wetland delineation and functional assessment for the proposed Wheatlands Solar Farm situated on the remaining Extent of farm Wheatlands 260 IQ, Gauteng.

1.1 Terms of Reference

The focus of the investigation is to:

- Delineate the wetlands according to standardised and accepted methods;
- Classify the wetland units according to the national wetlands inventory;
- Undertake the ecological functional assessment (PES, EIS) of wetland areas within the area assessed;
- Recommend suitable buffer zones;
- Determine potential impacts from the project and discuss mitigation and management procedures relevant to conserving wetland areas on the site.
- Undertake a Risk Assessment to determine if the project requires a water use license.

1.2 Assumptions and Limitations

- The wetland assessment is confined to the proposed development and 500m outside the boundary of the study site.
- The GPS used for wetland and riparian delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters in any direction. It is therefore suggested to measure and peg boundary areas in the field for higher accuracy.
- The on-site assessment of wetlands is based on environmental indicators such as vegetation that are subjected to seasonal variation as well as factors such as fire and drought. Wherever available, background information was gathered to aid in analysis of the site characteristics. Information provided within this report is based on observations made during the site survey on the specified date.
- Wetlands form transitional areas where vegetation species change from terrestrial to wetland species. Within this transition zone, some variation of opinion on the wetland boundary may occur, although all assessors should obtain relatively similar results when using the DWS methodology.
- Pans have unique diatom communities that could be impacted by developmentswhich have not been studied as it is outside of the scope of this study.

1.3 Definitions and Legal Framework

The NWA defines a wetland as "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat is described as "*the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas"*. Riparian habitats often perform important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005).

This document was prepared according to the Gauteng Department of Agriculture and Rural Development (GDARD) Requirements for Biodiversity Assessments Version 3, February 2014, as well as key legislative requirements and guiding principles of the wetland study and the Water Use Authorisation process. The proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- The National Water Act, 1998 (Act No. 36 of 1998) [NWA]
- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA].
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management: Protected Areas Act, 2003 (Act No. 57 of 2003).
- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA.
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).

Water uses for which authorisation must be obtained from DWS, are indicated in Section 21 of the NWA. Section 21 (c) and (i) is applicable to any activity related to a wetland:

Section 21(c): Impeding or diverting the flow of water in a watercourse; and
Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

Authorisations related to wetlands are regulated by Government Notices R.267 of 24 March 2017. GN R.267 of 2017 grants General Authorisation (GA) for the above water uses on certain conditions:

- Any activity in a wetland for the rehabilitation of a wetland for conservation purposes.
- Any activity more than 500 m from the boundary of a wetland.

These regulations also stipulate that these water uses must be registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a wetland are excluded from a GA under either of these regulations. Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (GN R267). Such an activity requires a Water Use Licence (WUL) from the relevant authority.

2 METHODOLOGY

An initial desktop study was conducted in order to gather background information on the site. The use of maps, aerial photographs and digital satellite imagery were consulted in order to assess the site conditions. GIS data was used to create maps describing the receiving environment, such as locality, soils, vegetation, critical biodiversity areas and hydrology.

A hand held GPS was used to capture co-ordinates in the field and a hand held camera for photographs. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital images containing delineation lines and buffers according to the field data received.

The delineation method documented by the Department of Water Affairs and Forestry in their document "Updated manual for the identification and delineation of wetlands and riparian areas" (DWAF, 2008), and the Minimum Requirements for Biodiversity Assessments (GDACE, 2009) as well as the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (SANBI 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas.

2.1 Wetland and Riparian Classification and Delineation

2.1.1 Wetland indicators

Wetlands are delineated by means of the Department of Water Affairs and Forestry guideline named 'A practical field procedure for identification and delineation of wetlands and riparian areas' (DWAF, 2008).

Wetlands are identified based on one or more of the following characteristic indicators (Figures 1 and 2):

- ***The Terrain Unit Indicator*** helps to identify those parts of the landscape where wetlands are more likely to occur. These include valley bottoms as well as slopes where groundwater discharge may occur.
- ***The Vegetation Indicator*** for the presence of plants adapted to saturated soils (hydrophytes). Vegetation growth helps in identifying the outer boundaries of a wetland since species composition changes dramatically between zones. Emphasis is placed on the group of species that dominate the plant community, and not on individual indicator species.
- ***The Soil Form Indicator*** identifies hydromorphic soils that display characteristics resulting from prolonged and frequent saturation and which are indicative of permanent, seasonal and temporary wetland zones. Gleyed soil has a grey, green or blue colour due to iron being dissolved out of the soil during anaerobic conditions. Seasonal or temporary wetlands generally have a fluctuating water table which creates alternating aerobic and anaerobic conditions in the soil. This causes iron to deposit over decades as yellow or orange patches, called mottles.
- ***The Soil Wetness Indicator*** to identify morphological changes due to anaerobic conditions developing in the first 50cm of the soil surface as a result of saturation. Specific soil colours and the presence of mottles are indicative of permanent or temporary saturation. The higher the frequency and duration, the more grey the soil matrix becomes. Hydromorphic soils that are permanently saturated generally do not show mottles.

According to the NWA, vegetation is the primary indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator is used as the primary indicator since it shows long term morphological changes from saturation, whereas vegetation is seasonal and responds quickly to changes in soil moisture, human activities and climate. All other indicators are used to confirm the presence of a wetland.

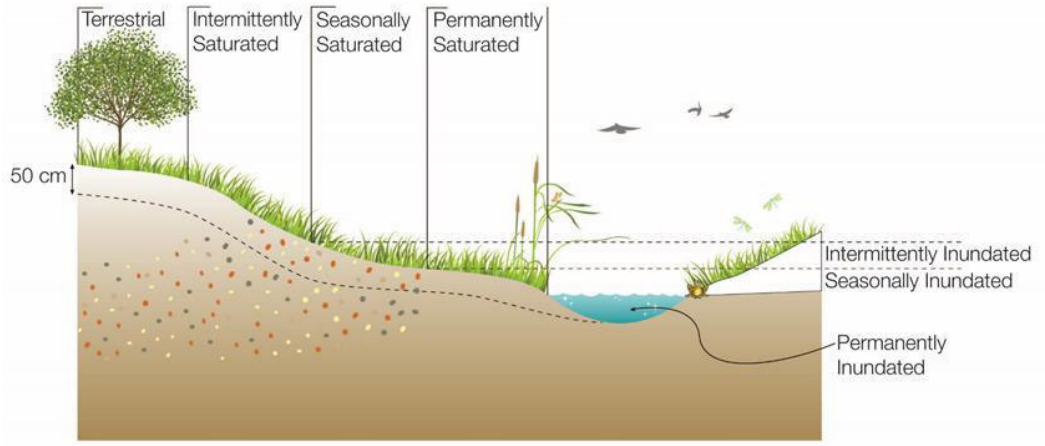


Figure 1: Typical section of a wetland (Ollis, 2013)

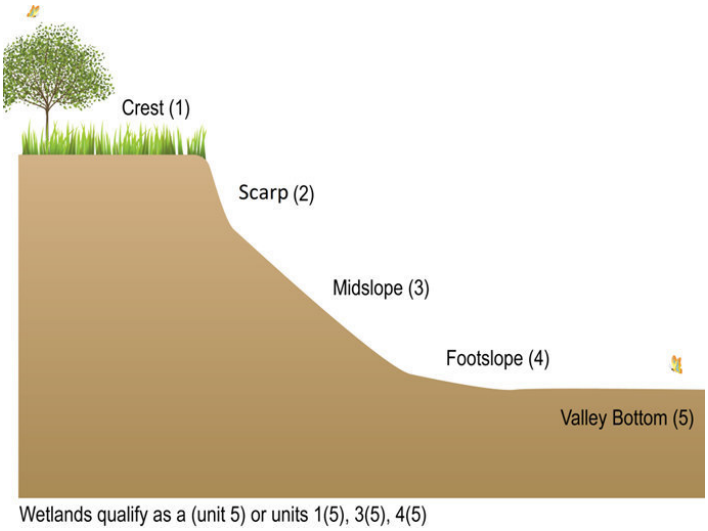


Figure 2. Terrain units (DWAF, 2005).

The boundary of the wetland is defined as the outer edge of the temporary zone of wetness, which is characterised by:

- A minimal grey matrix (<10%)
- Few mottles
- Short periods of saturation of less than 3 months per annum

2.1.2 Riparian Area

Riparian areas have specific characteristics, namely:

- are associated with a watercourse;
- contain distinctively different plant species than adjacent areas, exhibiting more vigorous or robust growth; and
- may have alluvial soils.

River channels flow within a confined valley or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Kotze, 1999). Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008). Riparian vegetation is supported by perennial and non –perennial streams.

Riparian areas perform valuable functions including:

• store water and help reduce floods;

• stabilize stream banks;

• improve water quality by trapping sediment and nutrients;

• maintain natural water temperature for aquatic species;

• provide shelter and food for birds and animals;

• provide corridors for movement and migration of species;

• a buffer between aquatic ecosystems and adjacent land uses;

• can be used as recreational sites; and

• provide material for human use.

It is possible to delineate riparian areas by checking for the presence of specific indicators. Some areas may display both wetland and riparian indicators, and can accordingly be classified as both. The riparian delineation process requires that the following be taken into account:

• Topography associated with the watercourse;

• Vegetation; and

• Alluvial soils and deposited material.

The most important indicator is vegetation, where the outer edge is adjacent to the watercourse where a distinct change in vegetation occurs. Topography and the presence of alluvial soils are the next indicators used to confirm the riparian area.

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel (Figure 3). Two types of temporary rivers are recognized, namely "ephemeral" rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and "episodic" rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman *et al,* 2010).

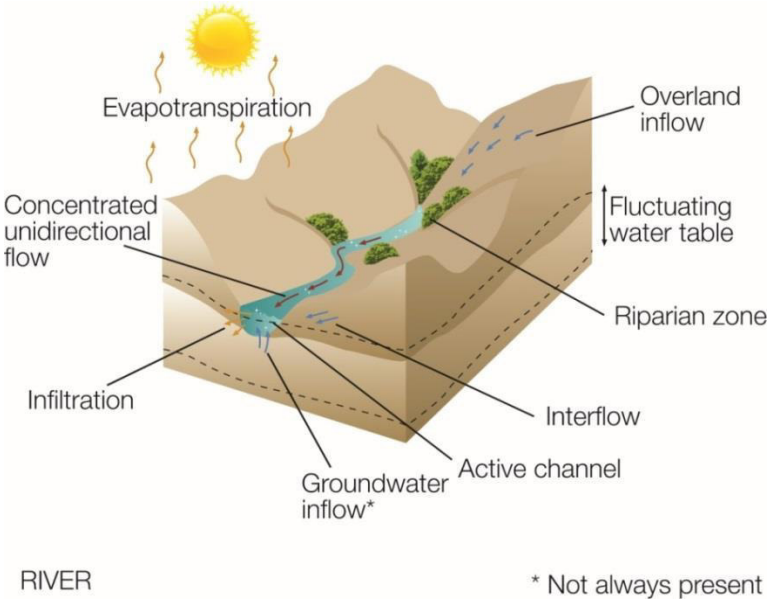


Figure 3: A schematic representation of the processes characteristic of a river area (SANBI 2013).

2.1.3 Wetland Classification

The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification as described by SANBI, 2009 (Figure 4). In general HGM units encompass three key elements (Semeniuk & Semeniuk 1995; Finlayson et al. 2002; Ellery et al. 2008; Kotze et al. 2008, Kotze *et al,* 2005), namely:

- Geomorphic setting - This refers to the landform characteristics and processes
- Water source - Precipitation, groundwater flow, stream flow, etc.
- Hydrodynamics – the presence and movement of water through the wetland.

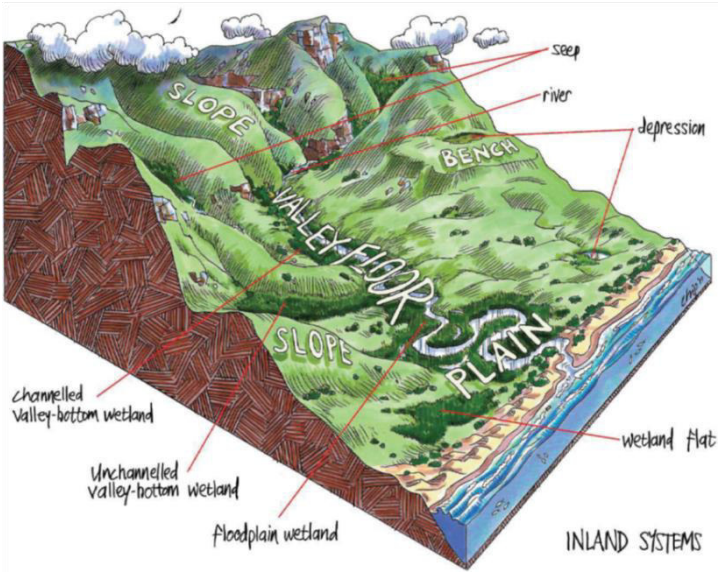
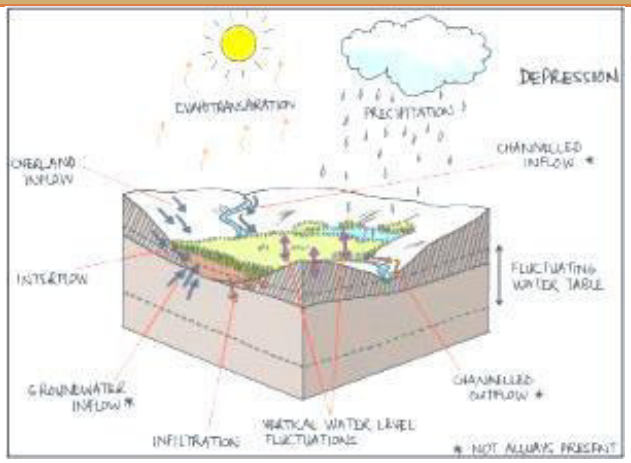
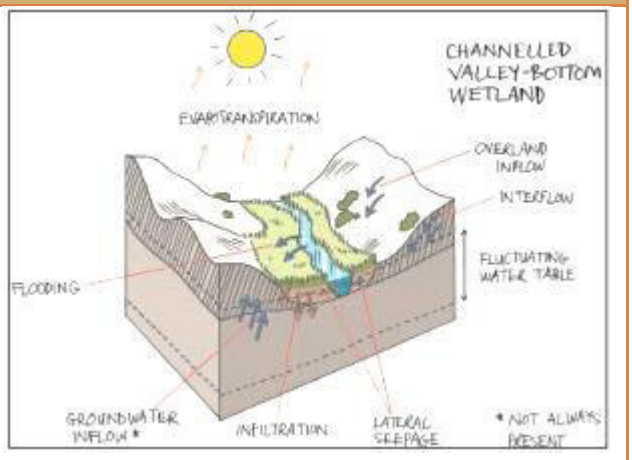


Figure 4: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

The Classification of wetland areas found during the study (adapted from SANBI, 2009) is as follows (Table 1):

Table 1: Wetland Hydro-Geomorphic types and descriptions

River and Riparian Area	Channelled Valley Bottom
	
Depressions are wetland or aquatic ecosystems with closed (or near-closed —1) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.	Channelled valley-bottom wetlands are characterised by their location on valley floors, the absence of characteristic floodplain features and the presence of a river channel flowing through the wetland.

2.2 Buffer Zones

A buffer zone is defined as *"a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted"* (DWAF, 2005). A development has several impacts on the surrounding environment and on a wetland. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments. The buffer zone serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind.

Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts of land uses / activities planned adjacent to water resources. These must however be considered in conjunction with other mitigation measures.

Local government policies require that protective buffer zones be calculated from the outer edge of the temporary zone of a wetland (KZN DAEA, 2002; CoCT, 2008; GDARD, 2012). Although research is underway to provide further guidance on appropriate defensible buffer zones, there is no current standard other than the generic recommendations and Buffer Tool (Macfarlane et al, 2013).

Wetland buffer requirements:

- 32 meters from the temporary zone for wetlands occurring inside the urban edge;
- 50 meters from the temporary zone for wetlands occurring outside the urban edge; and
- Larger buffer areas for wetlands supporting sensitive faunal or floral species.

Rivers (non-perennial/perennial) buffer requirements:

- A 100 meter buffer zone from the edge of the temporary zone outside the urban edge;
- A 32 meter buffer zone from the edge of the temporary zone inside the urban edge; and
- Larger buffer areas for aquatic ecosystems supporting sensitive species.

The DWS Buffer Guideline (McFarlane et al, 2013) is used to determine the scientific buffer requirements which may be more or less than the generic values.

2.3 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as "a measure of the deviation of wetland structure and function from its natural reference condition." The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions. The

hydrological, geomorphological and vegetation integrity are assessed for the wetland units associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane et al, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999).

In the current study the wetland was assessed using WET-Health (Macfarlane et al, 2007) and EIS (DWAF, 1999).

2.3.1 Present Ecological Status (PES) – WET-Health

A summary of the three components of the WET-Health method namely Hydrological, Geomorphological and Vegetation Health assessment for the wetlands found on site is described in Table 2.

Table 2: Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007)

Description	Impact Score Range	PES Score	Summary
Unmodified, natural.	>0.9	**A**	**Very High**
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 - 1.9	**B**	**High**
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2 - 3.9	**C**	**Moderate**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4 - 5.9	**D**	**Moderate**
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 - 7.9	**E**	**Low**
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	**F**	**Very Low**

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 3.

Table 3: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health (Macfarlane *et al*, 2007)

Change Class	Description	Symbol
Improve	Condition is likely to improve over the over the next 5 years	**(↑)**

Remain stable	Condition is likely to remain stable over the next 5 years	**(→)**
Slowly deteriorate	Condition is likely to deteriorate slightly over the next 5 years	**(↓)**
Rapidly deteriorate	Substantial deterioration of condition is expected over the next 5 years	**(↓↓)**

2.3.2 Ecological Importance and Sensitivity (EIS)

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). Explanations of the scores are given in Table 4.

This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use.

Table 4: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores (DWAF, 1999)

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4	**A**
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <=3	**B**
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <=2	**C**

Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1	**D**

2.3.3 Impact and Risk Assessment

The risk-based management approach developed by the DWS is required to be undertaken to determine if a Water Use License Application (WULA) is required. The approach is used to assess potential impacts on wetland habitats and takes into consideration control / mitigation measures when scoring the significance of the potential impact (i.e. post mitigation). The model outcome of the impacts is then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with NEMA in instances of uncertainty or lack of information by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted. Risks/Impacts are assessed for all stages of the project cycle including:

- Planning;
- Construction;
- Operation; and
- Rehabilitation.

The following section is taken verbatim from the Section 21(c) and (i) Risk-based Assessment and Authorisation document (hereafter referred to as DWS, 2015).

In terms of section 22 of the National Water Act (36 of 1998)(NWA) a person may only use water if it is permissible under Schedule 1, a continuation of an ELU, a GA, a licence or the requirement for a licence has been dispensed with under section 22(3). There are 11 different types of water uses contemplated in section 21, but the purpose of this Risk- Based Water Use Authorisation Guideline is to deal with section 21(c) and (i) water uses only.

Water use in terms of section 21(c) and (i) of the NWA is:

- (c) impeding or diverting the flow of water in a watercourse; and
- (i) altering the bed, banks, course or characteristics of a watercourse.

However, unlike some water uses referred to in section 21, e.g. (a) and (b) which are consumptive and whose impacts are usually clearly evident, easier to manage and quantifiable, section 21(c) and (i) water uses are non-consumptive and their impacts more difficult to detect and manage. They are also generally difficult to clearly quantify. However, if left undetected these impacts can significantly change various attributes and characteristics of a watercourse, and water resources, especially if left unmanaged and uncontrolled. Thus, the risks posed by section 21(c) and (i) water uses on watercourses and water resources are an important consideration during the authorisation of these water uses.

Risk-based management has value in providing an indication of the potential for delegating certain categories of water use "risks" to DWS regional offices (RO) or Catchment Management Agencies (CMA). Risk categories obtained through this assessment serve as a guideline to establish the appropriate channel of authorisation of these water uses. The DWS has therefore developed a risk assessment matrix to assist in quantifying expected impacts. The scores obtained in this assessment are useful in evaluating how the proposed activities should be authorised.

The formula used to derive a risk score is as follows:

RISK = CONSEQUENCE x LIKELIHOOD

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

LIKELIHOOD = FREQUENCY OF THE ACTIVITY + FREQUENCY OF THE IMPACT +LEGAL ISSUES + DETECTION

"RISK ASSESSMENT KEY" is based on the DWS 2015 publication: Section 21 (c) and (i) water use Risk Assessment Protocol. An explanation of the key is shown below in table 5 - 12. The assessment presented in this document is based on the Risk Assessment Toolkit discussed in DWS (2015).

Table 5: Severity

How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, and habitat)?	
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table 6: Spatial Scale

How big is the area that the aspect is impacting on?	
Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighboring areas (downstream within quaternary catchment)	3
National (impacting beyond seconday catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table 7: Duration

How long does the aspect impact on the resource quality?	
One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table 8: Frequency of the activity

How often do you do the specific activity?	
Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table 9: Frequency of the impact

How often does the activity impact on the resource quality?	
Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table 10: Legal Issues

How is the activity governed by legislation?	
No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table 11: Detection

How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property?	
Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table 12 below provides a description of the classes into which scores are sorted, and their implication for authorisation.

Table 12: Risk Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

3 RESULTS

3.1 Locality of the study site

The proposed study area is situated on the farm Wheatlands 260IQ in the West Rand of Gauteng. The R41 runs approximately 1.2km north of the study area and Randfontein is approximately 6km to the east. The Solar Farm site covers an area of approximately 20 hectares. Two options for 11kV overhead power lines that run from the Solar Farm to a substation are proposed. The lines start at 26°11'42.22"S, 27°37'18.18"E in the north eastern corner of the proposed solar farm and will join to an existing substation at 26°10'20.36"S, 27°39'55.88"E.

Option 1: Approximately 6.25km in length. This alignment runs east for approximately 1.42km, then turns north to follow the outer eastern gravel roads of the Wheatlands area to join the R41, then turns east towards the substation.

Option 2: Approximately 6.51km in length. This alignment runs directly east for approximately 2.21km, the turns north-east to cross a pan before turning north towards the substation.

3.2 Description of the Receiving Environment

A review of available literature and spatial data formed the basis of a characterisation of the biophysical environment in its theoretically undisturbed state and consequently an analysis of the degree of impact to the ecology of the study site in its current state.

Refer to Figures 5 – 9 below.

3.2.1 Land Use

The proposed development area is situated on agricultural land which is used for crops. The surrounding area consists of small holdings. Agricultural potential for the area is low to moderate and falls within the West Rand Agricultural Hub according to GDARD.

3.2.2 Hydrology:

The subject property is located in the Mooirivier quaternary catchment C23D and A21D which is part of the Upper Vaal water management area. The Rietfonteinspruit within the site flows south into the Wonderfonteinspruit, Mooi River and finally into the Vaal River. Ecological condition of the catchment is ***D*** – largely modified according to Kleynhans (1999).

3.2.3 Regional Vegetation:

The regional vegetation classification is Soweto Highveld Grassland of the Grassland Biome (Mucina & Rutherfod, 2006).

Soweto Highveld Grassland vegetation is within gently to moderately undulating landscape on the Highveld plateau. Vegetation is short to medium-high dense, tufted grassland dominated by *Themeda triandra*.

Undisturbed areas may contain small scattered wetlands, pans, and occasional ridges or rocky outcrops. Main grass species include *Elionurus muticus, Eragrostis racemose, heteropogon contortus, Tristachye leucotrix, Andropogon appendiculatus, Brachiaria serrata* and *Cynodon dactylon*. The vegetation unit is considered endangered with only a few patches on conserved land compared to a target of 24%. Nearly half of the area is transformed by cultivation, urban sprawl, mining and infrastructure. Some areas are flooded by dams and the erosion potential is very low.

3.2.4 Geology and soils:

The underlying geology is a mix of quartzite, shale and minor conglomerate. Soils have a limited depth and impeded internal drainage. Some rocky outcrops occur in the south east.

3.2.5 Gauteng Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. The eastern half of the site is located within an ecological support area. Ecological Support Areas are natural or heavily modified areas required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas. These areas maintain the ecological processes on which Critical Biodiversity Areas and Protected Areas depend. Some are irreversibly modified, but are still required as they still play an important role in supporting ecological processes.

Both alignment options cross irreplaceable areas and ecological support areas. The eastern half of the solar farm is situated on ecological support area. Smallholdings have been built within the ecological support areas north and west of Option 1.

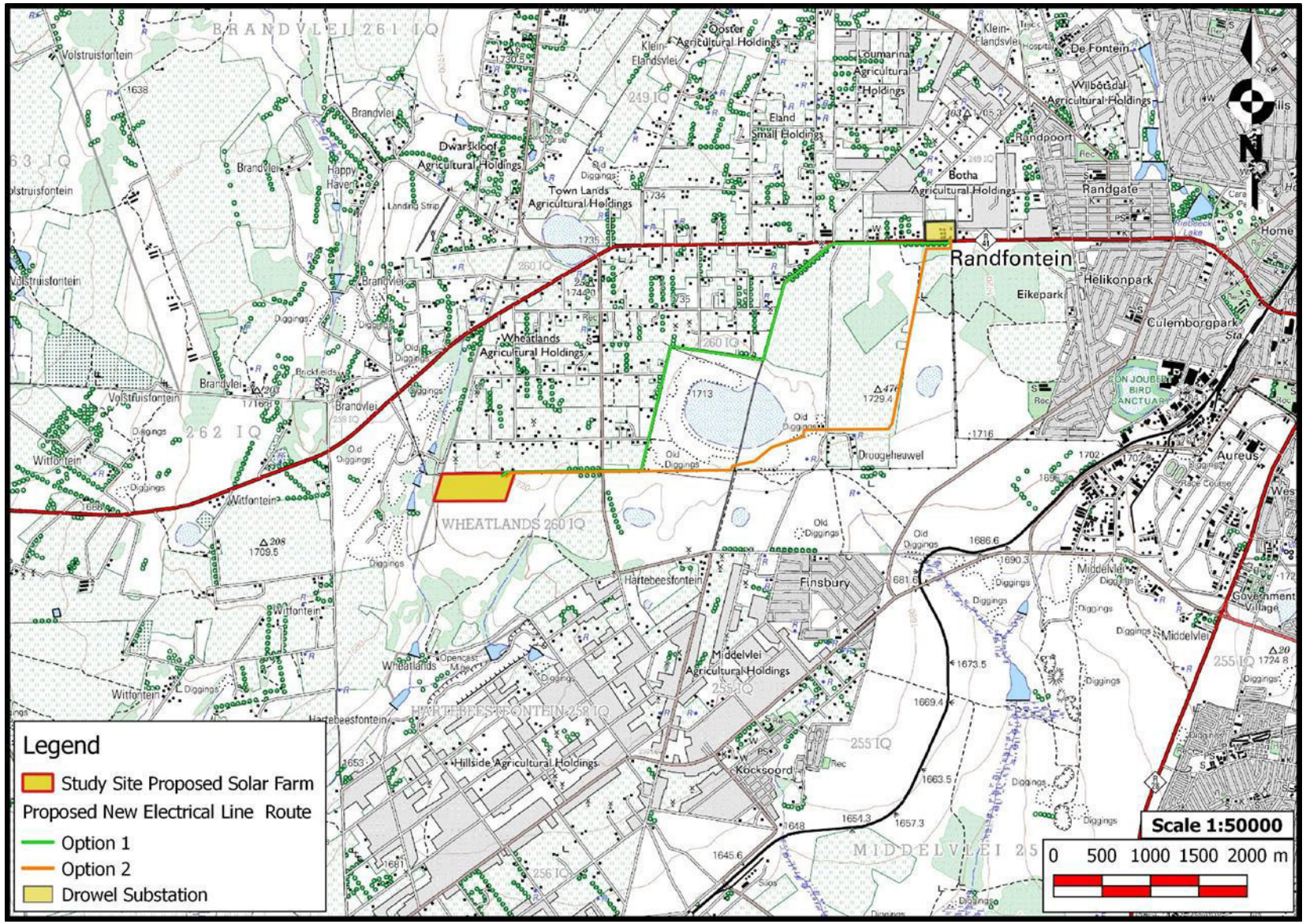


Figure 5: Locality Map

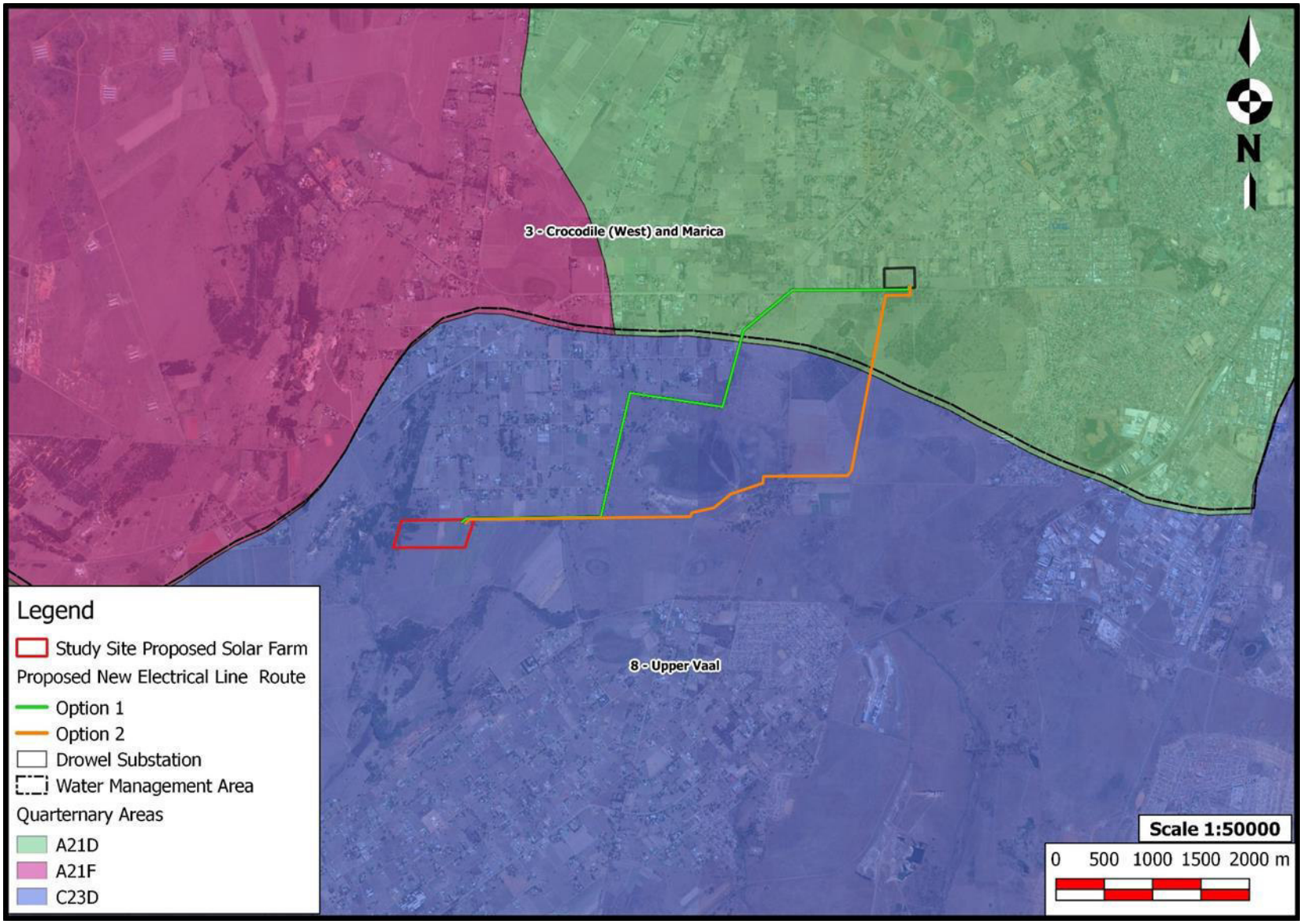


Figure 6: Hydrology of the study site and surrounds as per existing spatial layers.

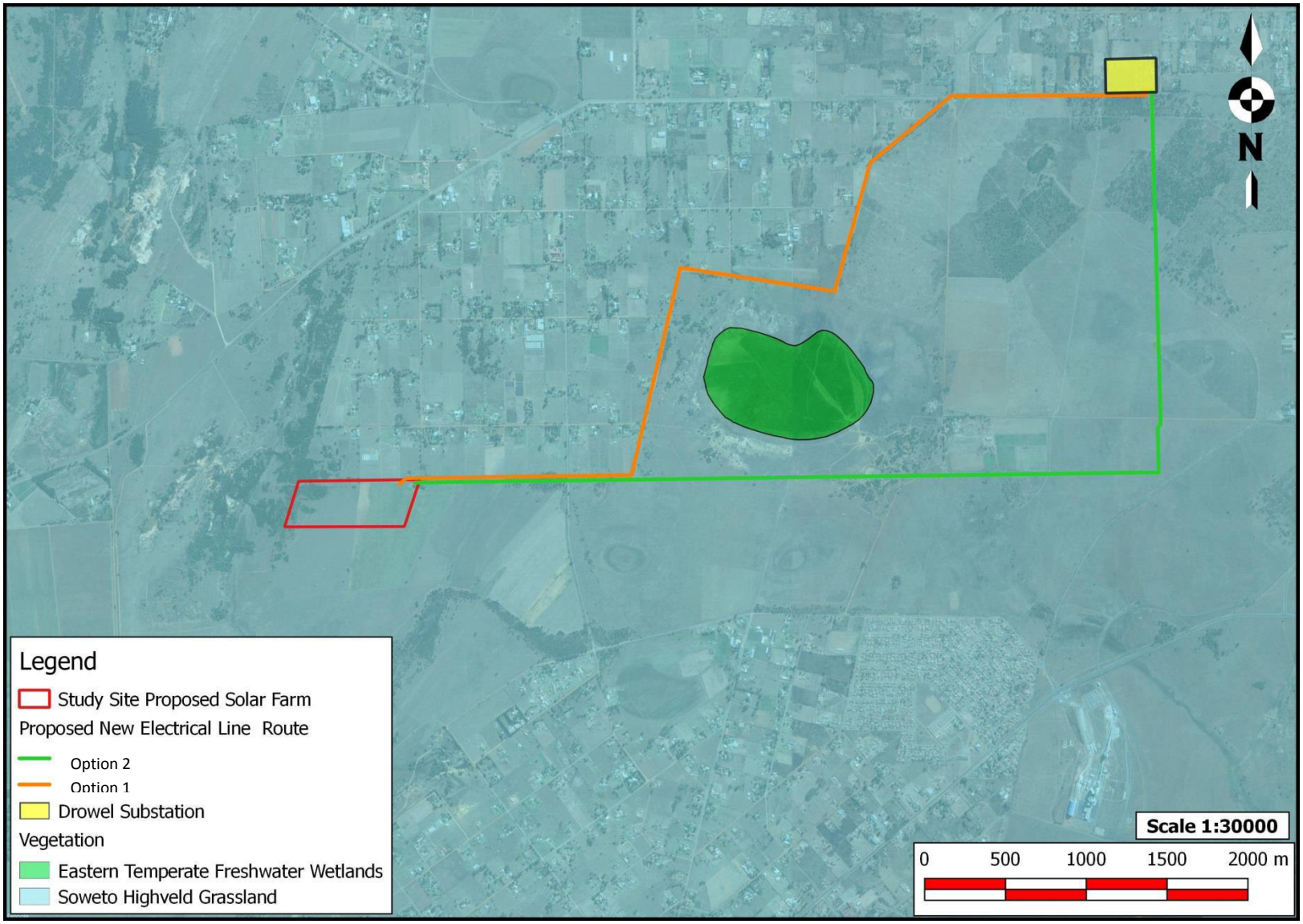


Figure 7: Vegetation types associated with the study site.

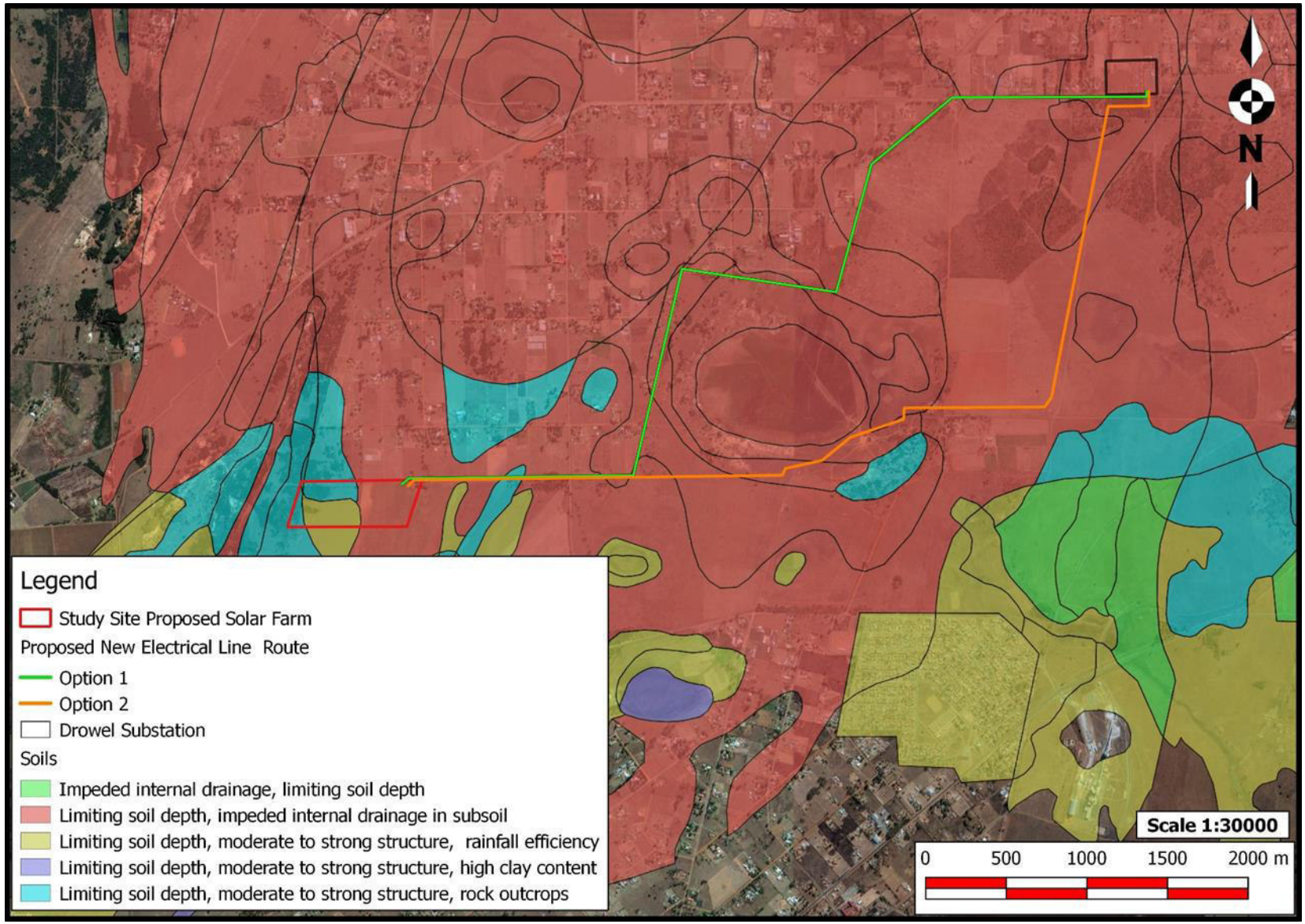


Figure 8: Soil classes of the study area.

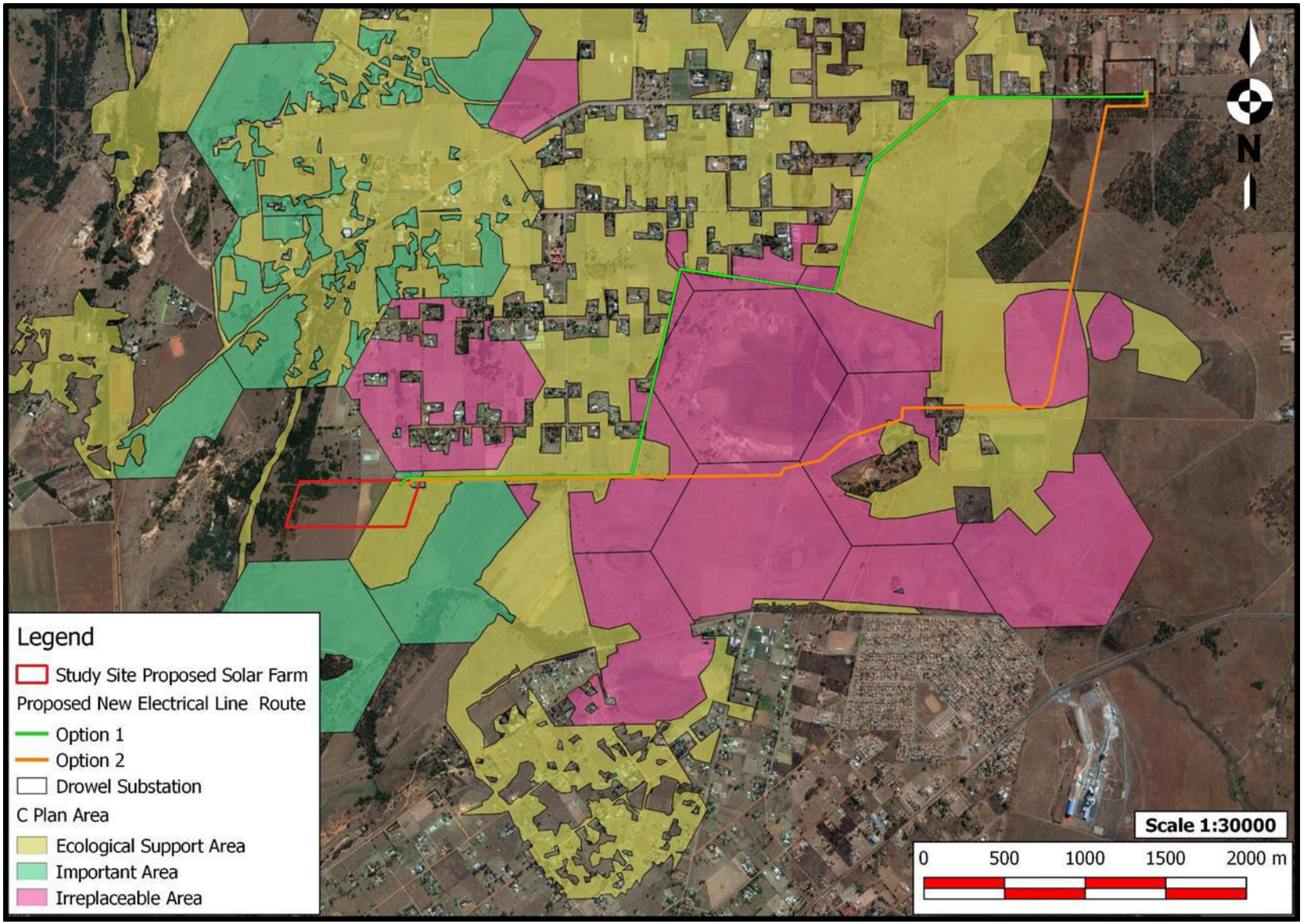


Figure 9: Gauteng C-Plan Map

3.3 Wetland Classification and Delineation

One wetland was found approximately 180m to the west of the solar farm site and is classified as a valley bottom with a channel (non-perennial stream).Vegetation in the surrounding area was mostly uniform with *Eragrostis curvula* and *Monocymbium ceresiforme* dominating the landscape, whereas water-loving species within the wetland were *Cyperacea* and *Paspalum dilatatum* forming dense basal cover. Bankrotbos (*Seriphium plumosum*) grows in scattered stands throughout the area adjacent to the wetland.

Three depression wetlands/pans occur in the study area. The pans were delineated during the dry season (August) and therefore vegetation species could not be accurately identified. However, a definite vegetation growth transition was identifiable between the temporary and seasonal zones and mottling occurred within the top 20cm of soil. The approximate central coordinates and sizes for each pan are:

Pan 1: 26°11'55.83"S, 27°38'2.92"E and 9.8 hectares

Pan 2: 26°11'57.24"S, 27°38'39.62"E and 3.29 hectares

Pan3: 26°11'22.11"S, 27°38'38.00"E and 62.8 hectares

Table 13: Dominant vegetation characteristics (van Oudshoorn, 2014):

Species	Characteristics
Wetland	
Cyperaceae	Mostly obligate wetland plants and prefer wet areas.
Paspalum dilatatum	Grows mainly in moist places and near rivers. Prefers clay to loam soil and can be a weed in gardens.
Fields	
Eragrostis curvula	Often found in disturbed areas, mainly overgrazed and trampled veld.
Themeda triandra	Common in undisturbed areas. Prefers moist and fertile soil.
Monocymbium ceresiiforme	Grows on slopes in high altitude and rainfall areas. Associated with leached acidic soil and sandy soil where water accumulates.
Heteropogon contortis	Prefers sandy loam to clay loam soils where some disturbance has occurred.
Melinis nerviglumis	Grows in moderate to high rainfall in undisturbed veld. Prefers shallow and gravelly soil.
Eragrostis racemosa	Grows in high rainfall grassland, bushveld and woodland. Grows in shallow sandy, gravelly soil in damp places or disturbed soil.

Figure 10a: Characteristics of the study site wetlands

1-3) valley bottom wetland characteristics

4-6) Pan 1 indicating; mottled sandy soils (4), vegetation transitional zones (5) and organic layer in permanent zone (6)

Figure 10b: Characteristics of the study site wetlands

1-3) Pan 2 indicating; permanent zone (1), pan vegetation transition (2) and mottled sandy loam soils (3)

4-6) Pan 3 indicating; permanent zone (4), clay soils (5) and roads within wetland (6)

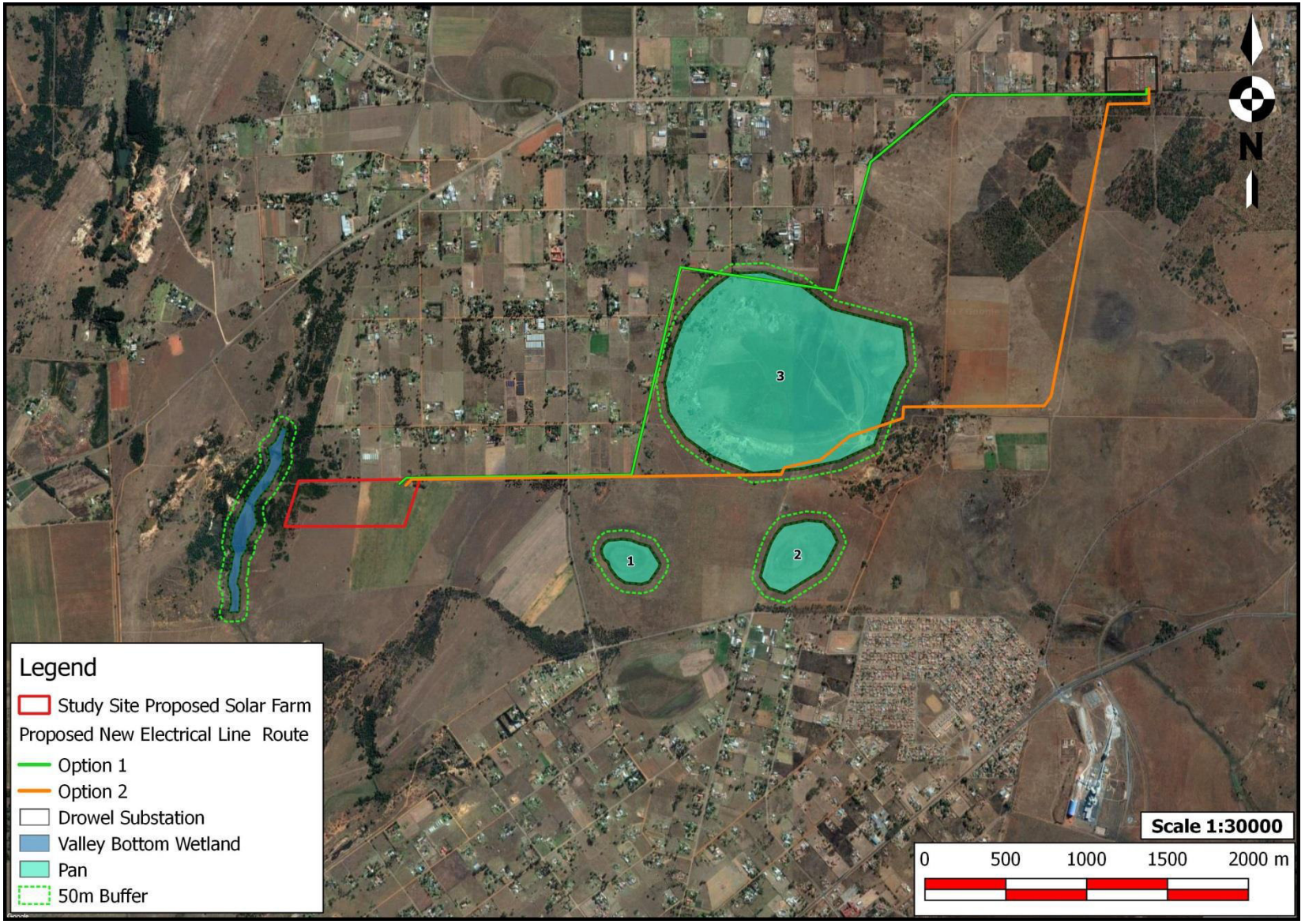


Figure 11: Wetland areas associated with the proposed activity including 50m buffer.

3.4 Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS)

The PES was calculated for the wetlands that occur within 500m of the proposed development and which are likely to be impacted by the proposed activities. The estimated **PES scores** for the wetlands as well as the estimated **EIS scores** are summarised in the tables below.

3.4.1 Valley Bottom Wetland

The valley bottom wetland has been impacted predominantly due to invasive plant growth and some trampling by cattle. Water has been dammed both upstream and downstream of the study site.

The combined **PES** score for the valley bottom wetland area is **2.5** and **C - Moderately modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. .

The expected trajectory of change is to remain stable should no further impacts occur on the wetland.

Table 14: The estimates present ecological state (PES) of the valley bottom wetland

		Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
Valley bottom wetland	Area weighted impact scores	4.0		1.4		2.2	
	PES Category	**D**	→	**B**	→	**C**	→

The **EIS** scores indicate that the study site is classed as **High** – the wetland is considered to be ecologically important and sensitive. The potential for direct human benefits is low, whereas the dense vegetation growth aids in sediment and pollutant trapping. The presence of small dams at regular intervals allows for the intermittent trapping of sediment and toxicants as water flows further downstream. The wetland is expected to be sensitive to habitat modifications from surrounding land use.

Table 15: The Ecological Importance and Sensitivity (EIS) of the valley bottom wetland

	Importance	Confidence
Ecological Importance & Sensitivity	2.0	3.5
Hydrological/Functional Importance	2.4	4.0
Direct Human Benefits	0.3	3.0
	2.4	**3.5**

3.4.2 Pan 1 and Pan 2

Pan 1 and Pan 2 showed almost identical characteristics and impacts and therefore are discussed together. The presence of water in the central portion of the pan is ideal for hydrophytic vegetation. Although vegetation growth was robust and most likely of wetland types, the species could not be confirmed due to the survey taking place during the dry season. Impacts on the pans include burning and grazing of livestock. Alien trees (such as the bluegum) are present in the upper catchments, but do not appear to have an identifiable effect on the wetland hydrology. A marsh owl was spotted in Pan 2 which is an indication of the value of the wetland as a habitat for fauna.

The combined **PES** score for Pan 1 and 2 are **0.93** and **A/B** - **Largely natural with few modifications.** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.

The expected trajectory of change is to remain stable should no further impacts occur on the wetland.

Table 16: The estimated present ecological state (PES) of Pan 1 and Pan 2

		Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
Pan 1	Area weighted impact scores	**1.0**		**0.0**		**1.8**	
	PES Category	**B**	→	**A**	→	**B**	→
Pan 2	Area weighted impact scores	**1.0**		**0.0**		**1.8**	
	PES Category	**B**	→	**A**	→	**B**	→

The **EIS** scores indicate that the study site is classed as **Moderate** – The wetlands are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications, however they do provide habitat for various faunal species.

Table 17: The Ecological Importance and Sensitivity (EIS) of Pan 1 and Pan 2

	Importance	Confidence
Ecological Importance & Sensitivity	1.8	3.5
Hydrological/Functional Importance	0.6	4.0
Direct Human Benefits	0.3	4.0
	1.8	**4.0**

3.4.3 Pan 3

Pan 3 is a large wetland with robust and varied hydrophytic vegetation growth. The wetland integrity has been impacted by tracks and roads which appear to be designed for 4x4 vehicle use. Hills and depressions have been created for these tracks which alter the water flow and lead to pooling in parts of the pan. Birdlife is abundant in the wetland and the thick vegetation growth provides nesting and feeding areas for species such as geese, sacred ibis, cattle egret etc.

The combined **PES** score for the wetland area is **1.4** and **B – Largely natural with few modifications.** A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.

The expected trajectory of change is to remain stable should no further impacts occur on the wetland.

Table 18: The estimated present ecological state (PES) of Pan 3

		Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
Pan 3	Area weighted impact scores	**2.0**		**0.4**		**1.8**	
	PES Category	**B/C**	↓	**A**	→	**C**	→

The **EIS** scores indicate that the study site is classed as **High** – the wetland is considered to be ecologically important and sensitive. The potential for direct human benefits is low, whereas the dense vegetation growth aids in sediment and pollutant trapping. A variety of habitats are present for various bird species and small mammals. The wetland is expected to be sensitive to habitat modifications from surrounding land use.

Table 19: The Ecological Importance and Sensitivity (EIS) of Pan 3

	Importance	Confidence
Ecological Importance & Sensitivity	2.0	3.5
Hydrological/Functional Importance	0.6	4.0
Direct Human Benefits	0.8	4.0
	2.0	**4.0**

3.5 Buffer recommendation

A 17m buffer has been determinded for the site using the buffer tool (MacFarlane et al, 2014). Calculations are shown in Appendix A.

A **50m** buffer for wetlands outside of the the urban zone are required by GDARD (2014) though the development will have minimal effect on the valley bottom wetland condition since the western outline of the site is found more than 180m from the wetland and the solar farm will not require any crossings or activites within this area. For the power lines, the footprint is small and therefore the impact is expected to be low with effective mitigation measures being in place.

3.6 Risk Assessment

Risks and impacts on watercourses are not notable and do not require mitigation measures on a higher level, which costs more and requires specialist input. In terms of section 22 of the National Water Act (36 of 1998) (NWA), a section 21 (c) and (i) water use license is not required for the Wheatlands development.

Refer to Table 20

3.7 Impacts and Mitigation

Impacts on the river and wetland are expected to be minimal from the proposed development. The distance from the Wheatlands Solar Farm to the valley bottom wetland is greater than 180m and no pipelines or power lines are planned to cross wetland areas. Powerlines have a small footprint and since no wetland crossings are required for the project, the impacts are expected to be low to negligible should mitigation measures be adhered to.

Recommendations were developed to address and mitigate impacts associated with the proposed project. These recommendations also include general management measures which should be applied during each phase of the proposed development. Mitigation measures address issues from planning, through construction and rehabilitation to after care and maintenance.

Refer to Table 21

Table 20: Risk Assessment Ratings

Phases	Activity	Aspects	Impacts	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
C	Clearing of vegetation in close proximity to a watercourse	Creating Access roads Creating safety clearance. Application of herbicides. Creation of fire breaks.	Loss of biodiversity and habitat. Pollution from sediment, vehicles and materials.	1	1	1	1	1	1	2	4	1	1	1	2	5	20	L
C	Construction of access roads through or in close proximity to a watercourse	Cutting/reshaping of riverbanks. Installation of culverts/pipes for stream crossings. Construction of low level bridges.	Loss of biodiversity and habitat. Pollution from sediment, vehicles and materials. Alteration or disruption of flow. Impeding flow. Damage to banks. Erosion of watercourse.	1	1	1	1	1	1	1	3	1	1	1	3	6	18	L
C/O	Erection of solar panels	Denuding the area. Excavation for foundations. Creating platforms for tower erection.	Loss of biodiversity and habitat. Pollution from sediment, vehicles and materials. Alteration or disruption of flow. Impeding flow. Damage to banks. Erosion of watercourse.	1	1	1	1	1	1	2	4	1	1	1	3	6	24	L
C/O	Erection of powerline pylons	Denuding the area. Excavation for foundations. Creating platforms for tower erection.	Loss of biodiversity and habitat. Pollution from sediment, vehicles and materials. Alteration or disruption of flow. Impeding flow. Damage to banks. Erosion of watercourse.	1	1	1	1	1	1	2	4	1	1	1	3	6	24	L
C/O	Erosion Control	Donga repair and filling for protection of infrastructure. Building of gabion walls. Installing berms. Stormwater structures.	Pollution from sediment, vehicles and materials. Alteration or disruption of flow. Impeding flow. Damage to banks. Erosion of watercourse.	1	2	2	1	1.50	2	2	5.5	2	2	1	1	6	33	L

C/O	Storm Water Management for the solar farm	Creating diversions in existing water courses. Putting in berms. Construction of drainage channels. Installations of gabions.	Pollution from sediment, vehicles and materials. Alteration or disruption of flow. Impeding flow. Damage to banks. Erosion of watercourse.	2	2	1	1	1.50	2	7	10.5	2	2	1	1	6	63	**L/M**
O	Maintenance of solar panels.	Vehicle movement through the site. Removal of materials	Pollution from dumped materials. Soil compaction.	1	1	1	1	1.00	2	4	7	2	2	1	1	6	42	**L**
O	Maintenance of powerlines.	Vehicle movement through the site. Removal of materials	Pollution from dumped materials. Soil compaction.	1	1	1	1	1	1	2	4	1	1	1	3	6	24	**L**
O	Removal of alien vegetation	Physical removal.	Positive impact.	2	2	2	1	1.75	2	4	7.75	1	1	1	1	4	31	**L**
O	Removal of alien/exotic vegetation	Use of herbicides.	Positive impact.	2	2	2	1	1.75	2	4	7.75	1	1	1	1	4	31	**L**

Table 21: The mitigation plan for Wheatlands.

Project Phase	Objectives	Mitigation Measures	Severity	
			Before Mitigation	After Mitigation
Planning/ Pre-construction	Minimise the footprint of the development	• An Environmental Management Programme and Storm Water Management Plan (SWMP) must be developed and be made available to the Ecological Control Officer (ECO) and be available on site for reference purposes. • Spatial and temporal placement of powerlines and construction areas should be placed as far from watercourses as possible and outside of buffer zones. • Access areas should be placed outside of buffer zones. • River crossings must be positioned where minimal disturbance of water movement occurs. • Culverts must be placed in river crossings at points where water flow is impeded as little as possible. • Geotechnical Engineers should be consulted for a management and rehabilitation plan. • Plan construction in proximity to watercourses to take place during the drier months. • The contractors must provide and maintain a method statement for "cement and concrete batching" which includes plans for storage and disposal of construction materials.	Medium	Low
Construction	Limit the area of disturbance/ site clearing and related impacts	• Construction boundaries and buffers should be clearly demarcated and fenced off. • Only use designated access roads and river crossing points. • River crossing points should be used as little as possible and limited to light vehicles. • Indigenous vegetation should not be removed where possible. • Traffic within sensitive areas should be limited. • Site clearing should be done immediately before construction to limit the time that soils are exposed. • Construction vehicles must not be allowed within wet areas and streams directly after rainfall.	Medium	Low
	Prevention of pollution of rivers and wetlands	• All pollutants should be stored in sealed containers in designated areas. • A bermed area away from watercourses should be used for cleaning of equipment and mixing of cement. • Vehicles and equipment should be cleaned, maintained and repaired in designated areas. • Drip trays must be used to prevent oil spills.	Medium	Low

		• Storage of materials may not be within the 1:100 flood lines, watercourses or associated buffer areas. • Solid waste/ refuse must be placed in designated areas and removed daily by appropriate methods. • In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Sanitation (DWS) must be informed immediately. • Adequate sanitation facilities must be supplied for workers away from sensitive areas. • Silt traps, berms, sand bags and/or barriers must be used along buffer zones to prevent sedimentation of watercourses • Prevent increased runoff by use of a SWMP.		
	Prevent loss of topsoil and vegetation	• Topsoil that is removed during construction should be stockpiled away from buffer zones. • Stockpiles should be replaced in open areas where construction does not occur. • Limit vegetation clearing. • Should Red data/ protected species be found on the site, they should be fenced off and no removal permitted. • Should red data species need to be removed, this should be done under the guidance of a flora specialist. Plants must be placed in a greenhouse and replanted in natural areas.	Medium	Low

4 CONCLUSION

The distance from the Wheatlands Solar Farm to the valley bottom wetland is greater than 180m and no power lines are planned to cross any wetlands, therefrore the impacts from the Solar Farm development are expected to be low. A comparison of the powerline alignment options indicates the following:

- Both options cross irreplaceable areas and ecological support areas.
- Option 1 covers a shorter distance along existing roads which will lower construction costs and time. The entire route follows existing roads throughout and is within 500m but further than 200m of Pan 1 and along the outer catchment edge of Pan 3.
- Option 2 crosses a greater part of the catchment and outer edges of Pan 3. The option covers a larger distance through irreplaceable and ecological support areas and is within 500m of all pans.

Based on this assessment, Option 1 is the preferred alignment from a wetland point of view. An environmental management plan and stormwater management plan must be developed to prevent and mitigate any impacts that may occur on the wetlands from the proposed development.

Risks and impacts on watercourses are not notable and do not require mitigation measures on a higher level. In terms of section 22 of the National Water Act (36 of 1998) (NWA), a section 21 (c) and (i) water use license is not required.

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APPENDIX A: BUFFER TOOL CALCULATION

Overall size	Size of the wetland relative to (as a percentage of) its catchment	Average slope of the wetland's catchment	The inherent runoff potential of the soil in the wetland's catchment	The extent to which the wetland (HGM) setting is generally characterized by sub-surface water input
(6-50) Intermediate	Small (<2%)	<3%	Low	Intermediate (The remaining HGM types)
Perimeter to area ratio	**Vulnerability of the HGM type to sediment accumulation**	**Vulnerability of the site to erosion given the site's slope and size**	**Extent of open water, particularly water that is naturally clear**	**Sensitivity of the vegetation to burial under sediment**
Low (<500 m per ha)	Channelled valley-bottom	Moderately Low (Vulnerability score: 2-3)	Low (0.5-3%)	Moderately high
Peat versus mineral soils	**Inherent level of nutrients in the landscape: is the wetland and its catchment underlain by sandstone?**	**Sensitivity of the vegetation to increased availability of nutrients**	**Sensitivity of the vegetation to toxic inputs, changes in acidity & salinization**	**Natural wetness regimes**
Mineral	No	Moderately low	Moderately low	Mix of permanently and seasonally saturated soils
Natural salinity levels	**Level of domestic use**	**Mean Annual Temperature**	Note: See the guideline document for further information on the rationale for indicator selection and how these attributes affect the sensitivity of wetlands to lateral inputs.	
Intermediate salinity levels	Low	Zone 3 (16.9 - 18.2 Deg C)		

Assess the sensitivity of important biodiversity elements to threats posed by lateral land-use impacts

	Threat Posed by the proposed land use / activity	Sensitivity: Water Resource	Sensitivity: Biodiversity	Site-Based Risk Class	Justification for increasing the sensitivity to cater for any important biodiversity elements including special habitats and species of conservation concern.
Construction Phase	1. Alteration to flow volumes	L		N/A	
	2. Alteration of patterns of flows (increased flood peaks)	M		VL	
	3. Increase in sediment inputs & turbidity	L		M	
	4. Increased nutrient inputs	L		N/A	
	5. Inputs of toxic organic contaminants	L		VL	
	6. Inputs of toxic heavy metal contaminants	L		L	
	7. Alteration of acidity (pH)	L		L	
	8. Increased inputs of salts (salinization)	L		N/A	
	9. Change (elevation) of water temperature	L		N/A	
	10. Pathogen inputs (i.e. disease-causing organisms)	L		VL	
Operational Phase	1. Alteration to flow volumes	L		M	
	2. Alteration of patterns of flows (increased flood peaks)	M		VL	
	3. Increase in sediment inputs & turbidity	L		VL	
	4. Increased nutrient inputs	L		VL	
	5. Inputs of toxic organic contaminants	L		M	
	6. Inputs of toxic heavy metal contaminants	L		L	
	7. Alteration of acidity (pH)	L		VL	
	8. Increased inputs of salts (salinization)	L		VL	
	9. Change (elevation) of water temperature	L		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	L		VL	

Refine desktop buffer requirements based on site-based investigations

Buffer attributes	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Slope of the buffer	Very Gentle (0 - 2%)			
Vegetation characteristics (Construction phase)	High: Dense vegetation, with good basal cover (e.g. natural grass stands)			
Vegetation characteristics (Operational phase)	High: Dense vegetation, with good basal cover (e.g. natural grass stands)			
Soil permeability	Moderate: Moderately textured soils (e.g. sandy loam).			
Topography of the buffer zone	Uniform topography: Smooth topography with no concentrated flow paths anticipated.			
Site-based aquatic impact buffer requirements (without additional mitigation measures)				
Construction Phase	17	Not Assessed	Not Assessed	Not Assessed
Operational Phase	15	Not Assessed	Not Assessed	Not Assessed

Where appropriate, identify additional mitigation measures and refine aquatic impact buffer width accordingly

	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class	Specialist justification for refined threat ratings with clear reference to supporting documentation.
Construction Phase	1. Alteration to flow volumes	N/A			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	H			
	4. Increased nutrient inputs	N/A			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	L			
	7. Alteration of acidity (pH)	L			
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	N/A			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			
Operational Phase	1. Alteration to flow volumes	M			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	VL			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	M			
	6. Inputs of toxic heavy metal contaminants	L			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	VL			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Revised aquatic impact buffer requirements (including additional mitigation measures)				
Construction Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Operational Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Additional mitigation measures to consider	Y/N	Comments
Have additional mitigation measures been identified to cater for any point-source discharges?		
Have additional mitigation measures been identified to cater for potential groundwater impacts?		

Where necessary review and refine aquatic impact buffer requirements to cater for practical management considerations

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Final aquatic impact buffer requirements (including practical management considerations)				
Construction Phase	17	Not Assessed	Not Assessed	Not Assessed
Operational Phase	15	Not Assessed	Not Assessed	Not Assessed
Final aquatic impact buffer requirement	17	Not Assessed	Not Assessed	Not Assessed

APPENDIX B: GLOSSARY OF TERMS

Activity	a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation
Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Duration	the length of time over which the stressor will cause a change in the resource or receptor.
Environmental aspect	an element of an organizations activities, products and services which can interact with the environment". The interaction of an aspect with the environment may result in an impact.
Frequency of activity	refers to how often the proposed activity will take place.
Frequency of impact	refers to the frequency with which a stressor (aspect) will impact on the receptor.
Hydrophyte	any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Hydromorphic soil	soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Impacts/ Risks	the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
Receptors	comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
Seepage	A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows.
Sedges	Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.
Severity	the degree of change to the receptor status in terms of the reversibility ofthe impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.

Spatial extent	the geographical scale of the impact
Soil profile	the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).
Wetland	"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." (National Water Act; Act 36 of 1998).
Wetland delineation	the determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures are included in impact assessment tables

APPENDIX C: CV OF SPECIALIST

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Work History

DELTERRA CONSULTING – Environmental Consultant
Wetland delineation
Ecological/ risk and impact assessments
Desktop analysis
Environmental Compliance

WETREST – Research as part of MSc in Aquatic Health

- "A Holocene Wetland: Hydrological Response to Rehabilitation at Colbyn Valley Wetland, Pretoria, Gauteng"
- Weekly groundwater level and pressure monitoring
- Isotope analysis
- Water quality monitoring
- Vegetation growth mapping

Education

MSC IN AQUATIC HEALTH – University of Johannesburg
BSC HONS IN ENVIRONMENTAL MANAGEMENT (CUM LAUDE) – UNISA
BSC AGRICULTURE – University of the Free State

Short Courses

FEB 2017	Taxonomy of wetland Plants (SANBI)
FEB 2016	Grass identification and veld management
NOV 2015	WRC/ ECO-PULSE Workshop in determination of buffers for rivers, wetlands and estuaries
APR 2015	Workshop on environmental compliance, enforcement and risk management

Projects

Wetland delineation, PES/EIS, functional assessment, Impacts and Mitigation, VEGRAI, QHI, Risk Assessments

Waterfall 5IR Wetland Rehabilitation and Action Plan, Gauteng

Eagle's Creek – Knopjeslaagte Rehabilitation Plan, Gauteng

Winterveld North Serwer Outfall, Soshanguve

Winterveld South Sewer Outfall, Soshanguve

Winterveld Residential Development, Soshanguve

Glen Vista Residential Development, Gauteng

Nkosi City Mixed-Use Development, Mpumalanga

Slovo Park – Nancefield Residential Development, Gauteng

Kudube Unit 9 Sewer Outfall, Gauteng

Mooibosch Resort Development, Gauteng

Hartebeeshoek Mixed-use Development, Gauteng

Wheatlands Solar Farm, Gauteng

Thula Mall, Bushbuckridge, Mpumalanga

Mthatha – Bedford City Mixed-use Development, Mthatha, Eastern Cape

Expansion of Transnet Railway Loops at Thabazimbi, Ferrogate and Northam, Limpopo

Riverwalk Electrical Line, Pretoria

Ormonde Residential Development, Johannesburg

Coal mining rights application for Berenice, Limpopo Province.

Ekhuthuleni Roads and Stormwater Upgrades

Proposed Housing Development on the Farm Middbuilt Position 11 and 81 and Eloff Erf 675, Delmas.

Kagisa and Environs Integrated Development and Housing Project, West Rand, Gauteng.

Witpoortjie Residential Development, Krugersdorp, Gauteng

Moretele Distribution Powerlines and Substations, Pretoria, Gauteng

Panfontein Access Road for Rand Water in Midvaal Local Municipality, Gauteng

Hawerklip Coal Siding at Brazen Algar, Delmas, Mpumalanga

Eskom Westgate - Ntshona Powerline, Gauteng Province

Ecological Importance and Sensitivity, and Present Ecological Status assessment for water use application for Soweto, Gauteng Province

Diepsloot East Powerline and Substation, Gauteng Province

Gem Valley Residential Development, Pretoria North

Amberfield Residential Development, Centurion

Environmental Compliance

The Construction of Two (2) 9km 88KV Tern Lines Section from Rigi Substation to Sonland Substation in Vereeniging, Emfuleni Local Municipality, Gauteng Province

APPENDIX E7

PHASE 1 HERITAGE IMPACT ASSESSMENT

PHASE 1 HERITAGE IMPACT ASSESSMENT (HIA) FOR THE PROPOSED WHEATLANDS URBAN SOLAR FARM ON THE REMAINING EXTENT OF THE FARM WHEATLANDS 260-IQ, RAND WEST MUNICIPALITY, GAUTENG PROVINCE

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For:

BOKAMOSO LANDSCAPE ARCHITECTS
& ENVIRONMENTAL CONSULTANTS
P.O. BOX 11375
MAROELANA
0161

July 2017

DISCLAIMER:

Although all possible care is taken to identify/find all sites of cultural importance during the initial survey of the study area, the nature of archaeological and historical sites are as such that it is always possible that hidden or sub-surface sites could be overlooked during the study. Leonie Marais-Botes Heritage Practitioner will not be held liable will not be held liable for such oversights or for the costs incurred as a result thereof.

ACKNOWLEDGEMENTS

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ABOUT THIS REPORT

The heritage report must reflect that consideration has been given to the history and heritage significance of the study area and that the proposed activities is sensitive towards the heritage resources and does not significantly alter or destroy the heritage significance of the study area.

The heritage report must refer to the heritage resources currently in the study area.

The opinion of an independent heritage consultant is required to evaluate if the proposed work generally follows a good approach that will ensure the conservation of the heritage resources.

The National Heritage Resources Act (Act 25 of 1999), the National Environmental Management Act (Act 107 of 1998), Ordinance on Exhumations (no 12 of 1980) and the Human Tissues Act (Act 65 of 1983 as amended) are the guideline documents for a report of this nature.

Leonie Marais-Botes was appointed by Bokamoso Landscape Architects and Environmental Consultants to carry out a Phase 1 Heritage Impact Assessment (HIA) for the proposed Wheatlands Urban Solar farm on the Remaining Extent of the Farm Wheatlands 260-IQ, Rand West Municipality, Gauteng Province. The site visit took place on 2 July 2017.

DEFINITION OF TERMS:

''alter'' means any action affecting the structure, appearance or physical properties of a place or object, whether by way of structural or other works, by painting, plastering or other decoration or any other means.

"archaeological'' means—
(a) material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;
(b) rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
(c) wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation; and
(d) features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found.

''conservation'', in relation to heritage resources, includes protection, maintenance, preservation and sustainable use of places or objects so as to safeguard their cultural significance.

''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

''development'' means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of a heritage authority in any way result in a change to the nature, appearance or physical nature of a place, or influence its stability and future well-being, including—
(a) construction, alteration, demolition, removal or change of use of a place or a structure at a place;
(b) carrying out any works on or over or under a place;
(c) subdivision or consolidation of land comprising, a place, including the structures or airspace of a place;
(d) constructing or putting up for display signs or hoardings;
(e) any change to the natural or existing condition or topography of land; and
(f) any removal or destruction of trees, or removal of vegetation or topsoil; object that is specifically designated by that state as being of importance.

''grave'' means a place of interment and includes the contents, headstone or other marker of such a place, and any other structure on or associated with such place.

''heritage resource'' means any place or object of cultural significance.

''heritage resources authority'' means the South African Heritage Resources Agency, or in respect of a province, a provincial heritage resources authority.

''heritage site'' means a place declared to be a national heritage site by SAHRA or a place declared to be a provincial heritage site by a provincial heritage resources authority.

''improvement'', in relation to heritage resources, includes the repair,
restoration and rehabilitation of a place protected in terms of Act 25 of 1999.

''living heritage'' means the intangible aspects of inherited culture, and may include—
(a) cultural tradition;
(b) oral history;
(c) performance;
(d) ritual;
(e) popular memory;
(f) skills and techniques;
(g) indigenous knowledge systems; and
(h) the holistic approach to nature, society and social relationships.

''local authority'' means a municipality as defined in section 10B of the Local Government Transition Act, 1993 (Act No. 209 of 1993).

''management'', in relation to heritage resources, includes the conservation, presentation and improvement of a place protected in terms of Act 25 of 1999.

''meteorite'' means any naturally-occurring object of extraterrestrial origin.

''object'' means any movable property of cultural significance which may be protected in terms of any provisions of Act 25 of 1999, including—
(a) any archaeological artefact;
(b) palaeontological and rare geological specimens;
(c) meteorites; and
(d) other objects.

''palaeontological'' means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trance.

''place'' includes—
(a) a site, area or region;
(b) a building or other structure which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure;
(c) a group of buildings or other structures which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures;
(d) an open space, including a public square, street or park; and
(e) in relation to the management of a place, includes the immediate surroundings of a place.

''presentation'' includes—
(a) the exhibition or display of;
(b) the provision of access and guidance to;
(c) the provision, publication or display of information in relation to; and
(d) performances or oral presentations related to, heritage resources protected in terms of Act 25 of 1999.

''public monuments and memorials'' means all monuments and memorials—
(a) erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government; or
(b) which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual.

''site'' means any area of land, including land covered by water, and including
any structures or objects thereon.

''structure'' means any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

''victims of conflict'' means—
(a) certain persons who died in any area now included in the Republic as a direct result of any war or conflict as specified in the regulations, but excluding victims of conflict covered by the Commonwealth War Graves
Act, 1992 (Act No. 8 of 1992);
(b) members of the forces of Great Britain and the former British Empire who died in active service in any area now included in the Republic prior to 4 August 1914;
(c) persons who, during the Anglo-Boer War (1899-1902) were removed as prisoners of war from any place now included in the Republic to any place outside South Africa and who died there; and
(d) certain categories of persons who died in the ''liberation struggle'' as defined in the regulations, and in areas included in the Republic as well as outside the Republic.

EXE**CUTIVE SUMMARY**

Leonie Marais-Botes Heritage Practitioner was requested by Bokamoso Landscape Architects and Environmental Consultants to conduct a Phase 1 Heritage Impact Assessment (HIA) for the proposed Wheatlands Urban Solar Farm on the Remaining Extent of the Farm Wheatlands 260-IQ, Rand West Municipality, Gauteng Provonce.

A field survey was conducted after which a survey of literature was undertaken.

No heritage sites situated on the site earmarked for development.

It should be noted that the sub-surface archaeological and/or historical deposits and graves are always a possibility. Care should be taken during any work in the entire area and if any of the above is discovered, an archaeologist/heritage practitioner should be commissioned to investigate.

1. INTRODUCTION

SolarReserve South Africa Management (Pty) Ltd is proposing to develop, construct and operate a 10MW with 1MW/4MWh battery storage Urban Solar Photovoltaic (PV) Power Plant and associated infrastructure on less than 20 ha of land, situated on the Remainder of the Farm Wheatlands 260 IQ, Randfontein Local Municipality, Rand West District Municipality, Gauteng Province. The proposed PV Power Plant produces energy by converting solar radiation into electricity. Power is generated by the solar cells (PV elements) during exposure to sunlight. The proposed development of the Wheatlands Urban Solar Farm shall consist of PV Panels that encase the solar cells. Solar cells are solid-state semiconductor devices that convert sunlight into direct-current electricity. The panels will be mounted on metal frames with a height of approximately 3m above the ground, supported by rammed, concrete or screw pile foundations, and they will face north in order to capture the optimum amount of sunlight. The facility will be of a fixed tilt nature. PV panels are typically up to 4m squared in size and will be situated in long rows, usually made up of approximately 100 m sections extending across the site. The study area is approximately 8.4km from Randfontein situated to the east, and is bordered by the Wheatlands Agricultural Holdings to the North, with the Middelvlei Agricultural Holdings occurring to the south. Road 6 occurs towards the east of the study area, which connects with the R41 (Lazar Road) to the north, and the R559 (Main Road) to the south. The proposed development site was historically used for crop cultivation and Eskom Servitude and powerline transects the northern boundary of the site from east to west. The PWV1 servitude runs along the western boundary of the site. A non-perennial streamflows (from north to south) approximately 250m to the west of the proposed development site. The Applicant will lease the land from the landowner for purpose of erecting and operating the proposed solar farm. The property is currently zoned “Agricultural” and a Consent Use Town Planning Application will be lodged to the involved local authority for the Urban Solar Farm.

1.1 WHY A PHASE 1 HERITAGE IMPACT ASSESSMENT IS REQUIRED?

This project may potentially impact on any types and ranges of heritage resources that are outlined in Section 3 of the National Heritage Resources Act (Act 25 of 1999). Subsequently a Phase 1 Heritage Impact Assessment (HIA) was commissioned by Bokamoso Landscape Architects and Environmental Consultants and conducted by Leonie Marais-Botes.

1.1.1 METHOD

The objective of this Phase 1 Heritage Impact Assessment (HIA) was to gain an overall understanding of the heritage sensitivities of the area and indicate how they may be impacted on through development activities. The site survey took place on 8 February 2017.

In order to establish heritage significance the following method was followed:

- Investigation of primary resources (archival information)
- Investigation of secondary resources (literature and maps)
- Physical evidence (site investigation)
- Determining Heritage Significance.

1.2 PROPERTY DESCRIPTION

Remaining Extent of the Farm Wheatlands 260-IQ, Rand West Municipality, Gauteng Province.

1.3 HISTORIY OF THE STUDY AREA

Randfontein is a town on the Western Witwatersrand, part of Krugersdorp (q.v.), but since 1929 a municipality on its own. It is 43 km. from Johannesburg, and has grown around the famous Randfontein Estates Gold Mine, established in its earliest days of the fields by Sir J.B. Robinson (q.v.). Randfontein Estates had the largest stamp battery in the world – 600 stamps. A pretty sheet of water, the Homestead Lake is among the attractions of the town[1].

1.4 LOCATION AND PHOTOGRAPHIC RECORD OF STUDY AREA

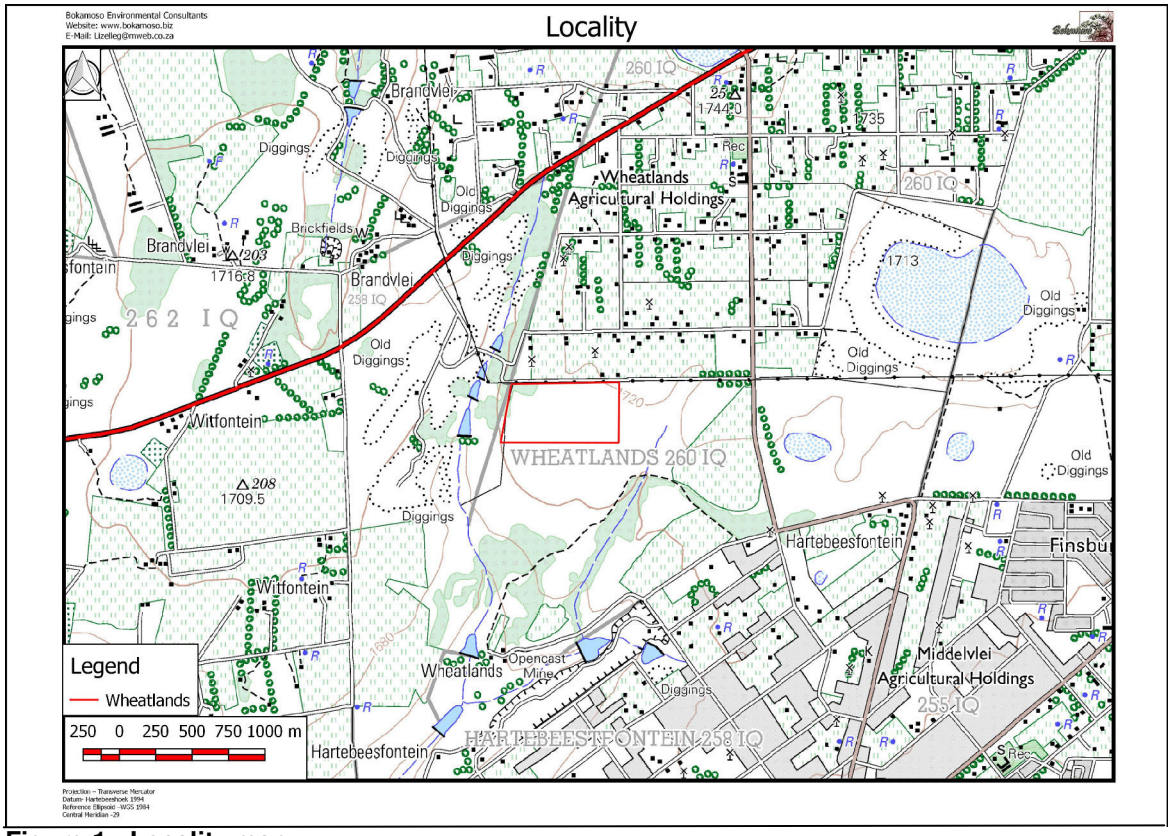

Figure 1: Locality map

[1] E. Rosenthal (Compiler and Editor), Encyclopaedia of Southern Africa, p. 455

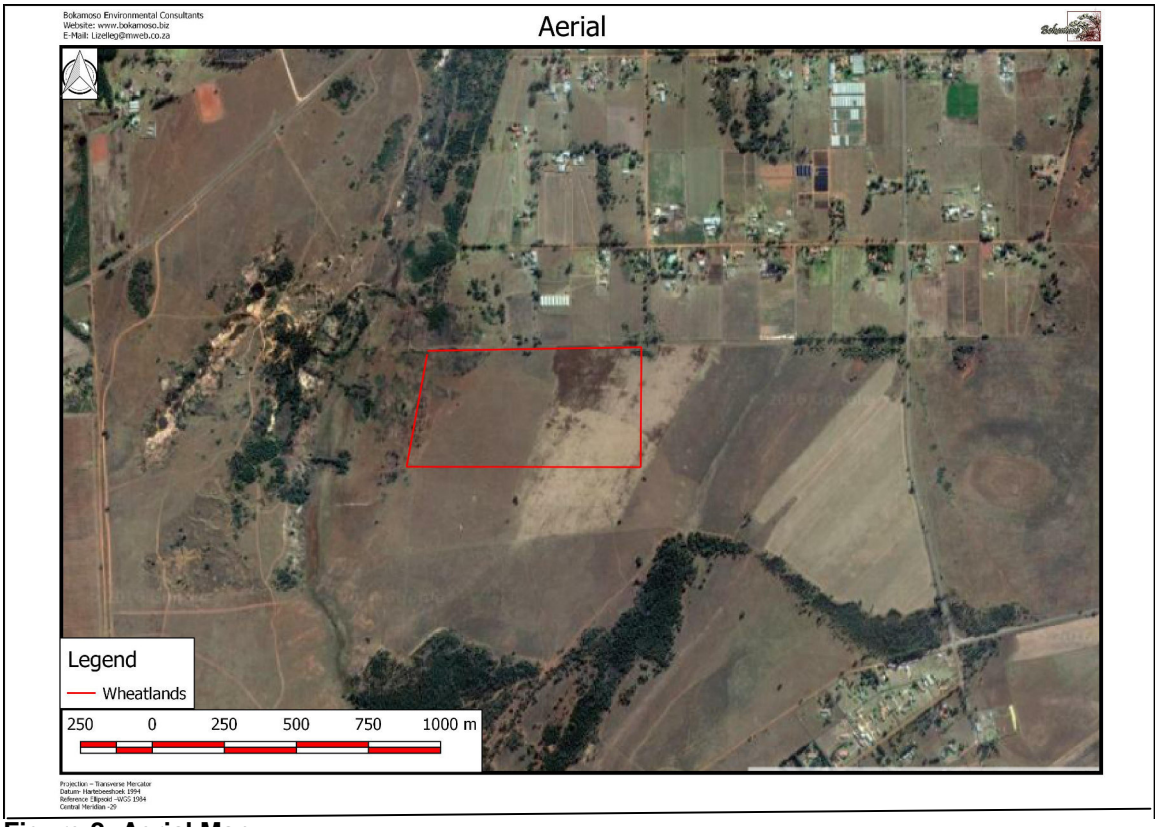

Figure 2: Aerial Map

Figure 3: Site characteristics

Figure 4: Site characteristics

Figure 5: Site characteristics

2. FINDINGS

2.1 PRE-COLONIAL HERITAGE SITES

Possibilities: Greater study area taken into account.

Stone Age

The Stone Age is the period in human history when stone material was mainly used to produce tools[2]. In South Africa the Stone Age can be divided in three periods[3];

- Early Stone Age 2 000 000 – 150 000 years ago
- Middle Stone Age 150 000 – 30 000 years ago
- Late Stone Age 40 000 years ago - +/- 1850 AD

Iron Age

The Iron Age is the period in human history when metal was mainly used to produce artefacts[4]. In South Africa the Iron Age can be divided in three periods;

- Early Iron Age 250-900 AD
- Middle Iron Age 900-1300 AD
- Late Iron Age 1300-1840 AD[5]

There are no pre-colonial heritage sites evident in the study area. This can be attributed to previous farming and other infra-structure development in the study area.

2.2 HISTORICAL PERIOD HERITAGE SITES

Possibilities: Greater study area taken into account.

- Pioneer sites;
- Sites associated with early mining;
- Structures older than 60 years;
- Graves (Graves younger than 60 years, graves older than 60 years, but younger than 100 years, graves older than 100 years, graves of victims of conflict or of individuals of royal descent).

None of the above situated on site.

2.3 ORIGINAL LANDSCAPE

Farming and previous infrastructure development has altered the original landscape in the study area.

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[2] P. J. Coertze & R.D. Coertze, Verklarende vakwoordeboek vir Antropologie en Argeologie.
[3] S.A. Korsman & A. Meyer, *Die Steentydperk en rotskuns* in J.S. Bergh (red) Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies.
[4] P.J. Coertze & R.D. Coertze, Verklarende vakwoordeboek vir Antropologie en Argeologie.
[5] M.M. van der Ryst & A Meyer. *Die Ystertydperk* in J.S. Bergh (red) Geskidenisatlas van Suid-Afrika. Die vier noordelike provinsies and T.N Huffman, A Handbook to the Iron Age: The Archaeology of Pre-Colonial Farming Societies in Southern Africa.

2.4 INTANGIBLE HERITAGE

The intangible heritage of the greater study area can be found in the stories of past and present inhabitants.

3 CATEGORIES OF HERITAGE VALUE (ACT 25 OF 1999)

The National Heritage Resources Act (Act 25 of 1999) identifies the following categories of value under section 3(1) and (2) of the Act under the heading "National Estate":

"3 (1) For the purpose of this Act, those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities.

(2) Without limiting the generality of subsection (1), the national estate may include-
- (a) places, buildings, structures and equipment of cultural significance;
- (b) places which oral traditions are attached or which are associated with living heritage;
- (c) historical settlements and townscapes;
- (d) landscapes and natural features of cultural significance;
- (e) geological sites of scientific or cultural importance;
- (f) archaeological and palaeontological sites;
- (g) graves and burial grounds, including-
  - (i) ancestral graves;
  - (ii) royal graves and graves of traditional leaders;
  - (iii) graves of victims of conflict;
  - (iv) graves of individuals designated by the Minister by notice in the Gazette
  - (v) historical graves and cemeteries; and
  - (vi) other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- (h) sites of significance relating to the history in South Africa;
- (i) movable objects, including-
  - (i) objects recovered from the soil or waters of South Africa including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
  - (ii) objects to which oral traditions are attached or which are associated with living heritage;
  - (iii) ethnographic art and objects;
  - (iv) military objects
  - (v) objects of decorative or fine art;
  - (vi) objects of scientific or technological interests; and
  - (vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section I (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

(3) Without limiting the generality of the subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of-
- (a) It is importance in the community, or pattern of South Africa's history;
- (b) Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- (c) Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;

(d) Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural objects;
(e) Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
(f) Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
(g) Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
(h) Its strong or special association with the life and work of a person, group or organisation of importance in the history of South Africa; and
(i) Sites of significance relating to the history of slavery in South Africa."

3.1 HERITAGE VALUE OF WEIGHED AGAINST CULTURAL SIGNIFICANCE CATEGORIES

3.1.1 Spiritual value

During the site visit/field work no indication of any spiritual activity was observed on/near the proposed site. Thus no sites of spiritual value will be impacted on by the proposed project.

3.1.2 Scientific value

No sites of scientific value were observed on or near the site earmarked for development.

3.1.3 Historical value

No historical value associated with the site could be found in primary and secondary sources.

3.1.4 Aesthetic value

No heritage item with exceptional aesthetic (architectural) value was identified in the study area.

3.1.5 Social value

Social value is attributed to sites that are used by the community for recreation and formal and informal meetings regarding matters that are important to the community. These sites include parks, community halls, sport fields etc. None of the said evident in the immediate study area.

3.2 SPECIFIC CATEGORIES INVESTIGATED AS PER SECTION 3 (1) AND (2) OF THE NATIONAL HERITAGE LEGISLATION (ACT 25 OF 1999)

3.2.1 Does the site/s provide the context for a wider number of places, buildings, structures and equipment of cultural significance?

The study area does not provide context for a wider number of places, buildings, structures and equipment of cultural significance. The reason being the low density of heritage items in the study area.

3.2.2 Does the site/s contain places to which oral traditions are attached or which are associated with living heritage?

Places to which oral traditions are attached or associated with living heritage are usually find in conjunction with traditional settlements and villages which still practises age old traditions. None of these are evident near or on the proposed site.

3.2.3 Does the site/s contain historical settlements?

No historical settlements are located on or near the proposed site.

3.2.4 Does the site/s contain landscapes and natural features of cultural significance?

Due to infra-structure development and farming activities the original character of the landscape has been altered significantly in the study area. Thus the site does not contain natural features of cultural significance.

3.2.5 Does the site/s contain geological sites of cultural importance?

Geological sites of cultural importance include meteorite sites (Tswaing Crater and Vredefort Dome), fossil sites (Karoo and Krugersdorp area), important mountain ranges or ridges (Magaliesburg, Drakensberg etc.). The proposed site is not located in an area known for sites of this importance.

3.2.6 Does the site/s contain a wide range of archaeological sites?

The proposed site does not contain any surface archaeological deposits, a possible reason is previous infra-structure development attempts and farming activities in the greater study area.

The possibility of sub-surface findings always exists and should be taken into consideration in the Environmental Management Program.

If sub-surface archaeological material is discovered work must stop and a heritage practitioner preferably an archaeologist contacted to assess the find and make recommendations.

3.2.7 Does the site/s contain any marked graves and burial grounds?

The site does not contain any marked graves or burial grounds.

The possibility of graves not visible to the human eye always exists and this should be taken into consideration in the Environmental Management Programme.

It is important to note that all graves and cemeteries are of high significance and are protected by various laws. Legislation with regard to graves includes the National Heritage Resources Act (Act 25 of 1999) whenever graves are 60 years and older. Other legislation with regard to graves includes those when graves are exhumed and relocated, namely the Ordinance on Exhumations (no 12 of 1980) and the Human Tissues Act (Act 65 of 1983 as amended).

If sub-surface graves are discovered work should stop and a professional preferably an archaeologist contacted to assess the age of the grave/graves and to advice on the way forward.

3.2.8 Does the site/s contain aspects that relate to the history of slavery?

This is not an area associated with the history of slavery like the Western Cape Province.

3.2.9 Can the place be considered as a place that is important to the community or in the pattern of South African history?

In primary and secondary sources the proposed site is not described as important to the community or in the pattern of South African history.[6]

3.2.10 Does the site/s embody the quality of a place possessing uncommon or rare endangered aspects of South Africa's natural and cultural heritage?

The proposed site does not possess uncommon, rare or endangered aspects of South Africa's natural and cultural heritage. These sites are usually regarded as Grade 1 or World Heritage Sites.

3.2.11 Does the site/s demonstrate the principal characteristics of South Africa's natural or cultural places?

The proposed site does not demonstrate the principal characteristics of South Africa's natural or cultural places. These characteristics are usually associated with aesthetic significance.

3.2.12 Does the site/s exhibit particular aesthetic characteristics valued by the community or cultural groups?

This part of the greater study area does not exhibit particular aesthetic characteristics valued by the community or cultural groups. The reason being the low density of heritage buildings and structures located in the greater study area.

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[6] Standard Encyclopaedia of Southern Africa and the TAB database at the National Archives of South Africa;
J.S. Bergh (red), Geskiedenisatlas van Suid-Afrika. Die Vier Noordelike Provinsies.

3.2.13 Does the site/s contain elements, which are important in demonstrating a high degree of creative technical achievement?

The site does not contain elements which are important in demonstrating a high degree of creative technical achievement. Reason being none of the above are evident on site.

3.2.14 Does the site/s have strong and special associations with particular communities and cultural groups for social, cultural and spiritual reasons?

The proposed site does not have a strong or special association with particular communities and cultural groups for social, cultural and spiritual reasons. No comment in this regard was received during the public participation period. See Bokamoso Landscape Architects and Environmental Consultants Public Participation Process (PPP) Report.

3.2.15 Does the site/s have a strong and special association with the life or work of a person, group or organisation?

No indication of the above could be found in primary and secondary research sources.[7]

4. RECOMMENDATIONS

- There are no visible restrictions or negative impacts in terms of heritage associated with the site. In terms of heritage this project can proceed.
- The discovery of subsurface archaeological and/or historical material as well as graves must be taken into account in the Environmental Management Program. If sub-surface archaeological and/or historical material as well as graves are discovered work must stop and a heritage practitioner contacted to assess the find/s and make recommendations.

5. WAY FORWARD

- Submit this report as a Section 38 Application in terms of the National Heritage Resources Act (Act 25 of 1999) to the Provincial Heritage Resources Authority of Gauteng (PHRA-G) for comment/approval.

[7] Dictionary of South African Biography (vol I-V) and the TAB database at the National Archives of South Africa

APPENDIX E8

OUTLINE SERVICE SCHEME REPORT

PROPOSED SOLAR FARM:

PORTION OF THE FARM WHEATLANDS 260IQ

AUGUST 2017

K&T PROJECT REFERENCE: 6884

REVISION 1

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CONSULTING ENGINEERS
REG. NO. 1966/09839/07
Engineering African Development

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Details of this report

Client Name:	SolarReserve SA Management (Pty) Ltd
Client Contact:	Ignatius de Wet
Document Title:	Outline Services Scheme Report
K&T Project Reference:	6884
File Name:	6884 Wheatlands OSR.docx

Report Revision Record

Revision	*Date*	*Description*
1	August 2017	Outline Scheme Report

This report has been prepared by Kantey & Templer (Pty) Ltd, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client.

We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.

For and on behalf of Kantey & Templer (Pty) Ltd	
Completed by:	Sean Dickinson
Signature(s):	
Reviewed & revised by:	
Signature:	
Approved by:	Francois Bain Pr Eng 980344
Signature:	

EXECUTIVE SUMMARY

INTRODUCTION

Kantey & Templer Consulting Engineers (K&T) has been appointed by SolarReserve (Pty) Ltd to compile an Outline Services Scheme Report in support of the proposed establishment of a solar farm facility on a portion of the Farm Wheatlands 260 IQ located within the West Rand District Municipality boundary.

WATER

Water will be provided via a water tanker and modular storage tanks provided on site.
The contractor will have to arrange with the Municipality for a metered water connection at the Finsbury Reservoir site to supply water during construction phase.

The developer will have to arrange with the Municipality for a metered water connection at the Finsbury Reservoir site to top up the modular water storage tanks as and when required during the operational phase.

No external water upgrades are required.

SEWER

Sufficient chemical toilets will be provided on site based on the maximum number of contractors available at any point in time during the construction phase. For every 20 labourers it is proposed to have a minimum of 1 chemical toilet. Male and female chemical toilets will be located separately on the site.

During the operational phase, a conservancy tank will be utilized to service the site. The developer will arrange with a Septic Tank Cleaners company to empty the conservancy tank approximately once a week during the operational phase.

SOLID WASTE REMOVAL

A dedicated refuse yard facility at a position internal to the site will be allocated. Refuse will be removed from site by the site operator and disposed of at an approved waste facility as recommended by West Rand District Municipality. It is planned to allow for recycling facilities to be provided on site.

STORMWATER

As the site will remain largely undisturbed apart from a small area for offices and equipment the increase in stormwater runoff will be minimal. It is proposed to provide some swales and berms to reduce run off from the site and create a natural sheet flow again and small attenuation facilities will be provided at strategic points on the site where there is a possibility of concentrated stormwater runoff occurring. A separate detailed stormwater management report is being prepared for approval by the relevant authorities.

ROADS

Access to the site will be via a graded gravel road to be constructed from Road 6 to the boundary of the site along the northern boundary of the Remainder of the Farm Wheatlands 260-IQ.
The road will be coated with a dust suppression solution to manage the dust in the area.

No construction will commence without final approved designs and wayleave from Council.

DUST CONTROL

The developer should comply with the National Dust Control Regulations that were promulgated on 1st November 2013 during the construction phase of the project.

During the construction phase, water tankers will be used to control the dust.

During operational phase it is planned to utilise a dust suppression solution in the final road layerworks. This will reduce both potential dust on the site as well as reduce maintenance requirements for the roads.

COST ESTIMATE: BULK CONTRIBUTIONS

The proposed development will have minimal impact on the council infrastructure and all services on site will be provided by the operator of the site. It is therefore not anticipated that Council will apply bulk contributions for the civil works on the site.

Detailed designs will be provided with the submission of any SDP plans to be submitted for approval. **No construction will commence without final approved designs and wayleave from Council.**

OUTLINE SCHEME REPORT FOR THE DEVELOPMENT OF A SOLAR FARM ON PORTION OF THE FARM WHEATLANDS 260IQ

CONTENTS PAGE

ITEM **PAGE**

LIST OF APPENDICES:

A: DRAWINGS

6884 - OSR-01-A – Locality Plan
6884 - OSR-01-A – Aerial Photograph
6884 - OSR-01-A – Access
6884 – OSR-01-A – Site Layout Plan

1. INTRODUCTION

1.1 BACKGROUND

Kantey & Templer Consulting Engineers (K&T) has been appointed by SolarReserve SA Management (Pty) Ltd to compile an Outline Services Scheme Report in support of the proposed solar farm to be established on a portion of the Farm Wheatlands 260 IQ which is located within the West Rand District Municipality.

The Farm Wheatlands 260 IQ is located to the west of the Randfontein CBD and is bound by Middelvlei AH to the south and the R41 (Lazar Avenue is located just to the north of the site).

The portion of the farm that will be utilised for the solar farm is located in the western portion of the farm and will comprise approximately 19.97Ha in total out of the full farm area of approximately 905Ha. It must be noted that there is currently a township application in for the full Wheatlands Farm portion which would allow for development of up to 13540 erven of mainly residential units and supporting uses. The engineering reports for the full development were prepared by SCIP Consulting Engineers.

The site locality is shown on drawing no. **6884A-OSR-01-A: SITE LOCALITY** in **Annexure A.**

1.2 SCOPE OF REPORT

The scope of this report is:

- Identify location of available existing services.
- Determine if existing services need to be extended.
- Determine connection points for site services.
- Specify design standards of proposed services
- Assess impact of the rezoned site on existing services and determine if upgrades are required
- If upgrades are required, determine size and extend of upgrades to existing services
- Cost estimate for internal and external services, bulk contributions

The engineering services addressed in this report are:

- Potable water and fire water supply
- Sewerage
- Solid waste removal
- Stormwater drainage
- Road infrastructure

No architectural layout has been prepared for the development at the time of compiling this report. Therefore, the services connections for the site are indicative.

1.3 PROJECT TEAM

Client:	SolarReserve Sa Management (Pty) Ltd
Town planner:	Hunter Theron Town Planners
Civil engineer:	Kantey & Templer (Pty) Ltd

2. SITE DESCRIPTION

2.1 TOPOGRAPHY & LOCATION

Location:	The site is located on the western portion of the Farm Wheatlands 260IQ which is in turn located due west of the Randfontein CBD and is bound by the R41 to the north with Wheatlands AH located along the northern boundary and Middelvlei AH located to the south.	
Current Land Use Zoning:	Agricultural	
Existing structures:	Undeveloped with farming activities taking place on large areas of the entire Farm portion.	
Level & fall of terrain:	The portion of land being considered for the solar site falls gently from east to west and towards the natural drainage valley located approximately 300m further west of the site.	
Vegetation:	Grasslands with a few scattered shrubs and small trees on western side of the site. The eastern side of the site is ploughed lands currently unutilised.	
Geology & soil:	A geotechnical report for the larger Wheatlands development has been prepared.	
Surrounding Land Use:	North	Small Agricultural Holdings
	East	Farmland and future Wheatlands Township development
	South	Farmland and future Wheatlands Township development
	West	Farmlands and future PWV1 Road reserve.

2.2 PROPOSED ZONING & LAND USE

Proposed Land Use Zoning:	Unchanged still farmlands
Height Zone:	NA
Coverage:	NA
Floor Area Ratio (FAR):	NA
Density:	NA.
Servitudes:	NA
Parking:	NA

3. WATER

3.1 EXISTING WATER INFRASTRUCTURE

3.1.1 DESCRIPTION

Currently there are no water services available on the boundary of the site.

The closest bulk water infrastructure is the Finsbury Reservoir located to the south of the site.

With the planned development of Wheatlands Township it is anticipated that significant upgrading of the water infrastructure will be provided but for the purposes of this report it is assumed that there will be no municipal water available on site.

3.1.2 AVAILABLE PRESSURE

Not applicable

3.2 WATER DEMAND

3.2.1 CONSTRUCTION PHASE

The largest demand for water will be during the construction phase of the solar farm. It is anticipated that water will be supplied to the site via water tankers and demand is not anticipated to exceed 5000 to 10000l per day during the construction phase.

The developer should comply with the National Dust Control Regulations that were promulgated on 1 November 2013 during the construction phase of the project.

3.2.2 OPERATIONAL PHASE

Once the solar farm is operational water demand will reduce significantly and will only be required to support a handful of staff (Max 10 persons) and will be used for the following purposes

- PV panel cleaning;
- service water for maintenance;
- potable use and ablutions;
- dust suppression (mostly during construction);
- irrigation during rehabilitation; and
- fire protection water.

The annual water demand for the development is not anticipated to exceed 1000 m^3. The average daily demand is therefore not expected to exceed approximately 500l/day based on 10 persons at 50l per day and on occasion higher demand of up to 3000l/day when wash down of the solar panels occurs and general maintenance work is required.

3.3 PROPOSED SERVICES

3.3.1 MATERIALS

For the purpose of this report, there will be no municipal water supplied to the site and it is not recommended that a borehole is provided due to environmental considerations. Therefore the proposed solution is to provide an elevated modular water storage tank of 15000l (to be confirmed upon final development requirements) which would be able to meet the normal monthly requirements of the site.

During the construction phase, it will be the responsibility of the contractor to arrange with the Local Municipality for a water supply to fill up all water trucks and water bowsers. This can be by means of a connection on the bulk water line, with a contractors bulk meter to keep track of water usage. It is proposed that the connection is taken off a waterline within the Finsbury Reservoir site.

During the operational phase, it will be the responsibility of the developer to arrange with the Local Municipality to install a bulk water meter at a safe point where the water tankers can top up. It is proposed to utilise the Finsbury Reservoir site where a meter can be installed on the existing council system. This meter can be locked and only utilised by the Developer to fill their tankers and they would be billed for water usage on a monthly basis.

3.3.2 EXTERNAL SERVICES

No external services need to be constructed.

3.3.3 INTERNAL SERVICES

The internal water reticulation network will be designed once the internal Site Development Plan (SDP) is finalised by the Architect and it will be submitted separately to council for scrutiny and comment. However it is anticipated that a standard 20mm HDPE Class 12 pipe system would be sufficient for the site.

Basic fire fighting requirements would be supplied from the storage tank where a fire hose reel and booster pump can be installed however for the bulk of the site it will be necessary to service the site with a fire tender vehicle.

3.3.4 SERVITUDES

No servitudes are required for the water services.

4. SEWER

4.1 EXISTING INFRASTRUCTURE

There is no municipal sewer infrastructure available on the boundary of the site.

With the planned development of the Wheatlands Township there will be the possibility of gravity sewer being installed in the vicinity of the site but for the purposes of this report it will be assumed that there will be no gravity sewer available.

4.2 DESIGN DISCHARGE

Given the very low potential sewer effluent that would be generated on the site it is not planned to install any form of sewer treatment facility.

4.3 PROPOSED SERVICES

4.3.1 CONSTRUCTION PHASE

It is proposed to service the site by means of chemical toilets in the short term during the construction stages of the project. Sufficient chemical toilets will be provided based on the maximum number of contractors available at any point in time. For every 20 labourers it is proposed to supply minimum of 1 chemical toilet during construction phase. The female chemical toilets will be located at a different location than the male toilets.

The developer should comply with the National Dust Control Regulations that were promulgated on 1 November 2013 during the construction phase of the project.

4.3.2 OPERATIONAL PHASE

Once the solar farm is operational the sewer discharge will reduce significantly and will only be required to support a handful of staff (Max 10 persons). It is planned to provide a small conservancy tank of approximately 5000l which would be emptied on a regular basis by means of a “honey sucker”. If the solar farm is operated with full staff, the conservancy tank will have to be emptied once every 10 days. The effluent would then be disposed of at an approved discharge point as indicated by the Randtfontein Council. The effluent from the site would then be treated at the Hannes Van Niekerk Sewer treatment works located in Westonaria which currently has a capacity of 64Ml/d.

It is proposed that the developer arrange with a Septic Tank Cleaners company to empty the conservancy tank once every 10 days.

4.3.3 INTERNAL SERVICES

The internal sewer network will be constructed using 110mmØ uPVC Class 34 pipes with a minimum fall of 1:60.

5. SOLID WASTE REMOVAL

There will be a dedicated refuse yard facility for the proposed development, located at a position internal to the site. Details and positions of the refuse yards will be shown on the architect’s Site Development Plan (SDP) for approval.

5.1.1 CONSTRUCTION PHASE

The type of waste generate during construction phase is general, domestic and construction waste. Each construction company will be responsible for their own generated solid waste and the disposal thereof.

5.1.2 OPERATIONAL PHASE

The type of waste during operational phase is only domestic waste and will be minimal. A dedicated refuse yard will be on site. It is planned to allow for recycling to take place on the site and dedicated bins for the various waste will be provided such as glass, paper, plastic.

6. STORMWATER

6.1 EXISTING INFRASTRUCTURE

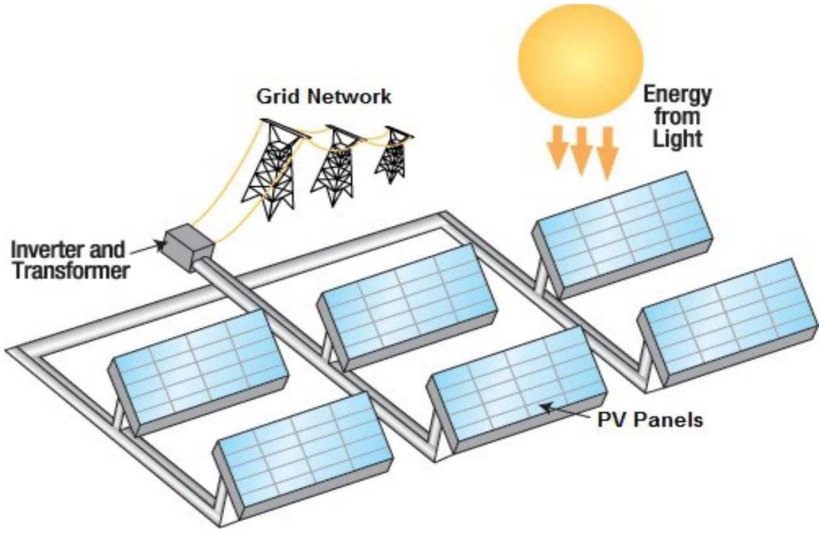
There are no existing stormwater networks near the boundaries of the site. The site slopes towards the western boundary and drains towards the natural drainage valley. As the site is currently natural grasslands and ploughed fields there is very little stormwater runoff generated by the site

6.2 ATTENUATION

6.2.1 COUNCIL REQUIREMENTS

As the ground cover across the site will remain largely natural and grassed with the exception of the operational facilities the stormwater runoff will not increase significantly over the whole site. It is anticipated that small attenuation facilities and silt traps will be required on the site and this will be determined once the final site layouts are designed.

Typical layout



Both the internal and external stormwater systems will need to be designed and submitted for approval with the SDP drawings.

6.2.2 COUNCIL REQUIREMENTS

- West Rand District Municipality requires the integration of environmental components with engineering components as part of sustainable catchment management.
- Minor and major stormwater and environmental systems should be interlinked to form an ecological system that prioritises water quality management.
- Peak discharge, Discharge Volume, Runoff frequency and water quality are to be considered during stormwater runoff management.

6.3 FLOODLINES & WETLANDS

The site is not impacted by the 1:50 and the 1:100 year flood lines. Therefore, a flood hydrology analysis due to the impact of the 1:50 and the 1:100 year flood lines for the proposed development is unwarranted, as specified by Chapter 14, Part 3 of the Water Act (Act 36 of 1998), as required in terms of the Town Planning and Townships Ordinance (Ordinance 15 of 1986).

6.4 PROPOSED SERVICES

6.4.1 CONSTRUCTION PHASE

It is proposed to install two rows of hale bales along the western boundary of the site during the construction phase. This will act as a barrier to prevent silt and debris from washing off the site.

6.4.2 MINOR SYSTEM - OPERATIONAL PHASE

The minor system refers to the internal stormwater infrastructure on the site.

- At any hardstand areas and structures to accommodate the operations of the plant that will generate stormwater will be provided with drain pipes and an underground piped system that will be directed to an appropriate open area in the site. Stormwater will be discharged by means of dissipators to spread the flow evenly across the ground.
- At any areas that will concentrate stormwater it is proposed to provide earth berms and swales to hold back the flow of stormwater and to allow the water time to infiltrate in to the ground.
- It is proposed to harvest rain by means of a tank to collect water from the roof tops. This can be used for irrigation purposes. This will require the installation of suitable guttering and piping to transport rainwater to the tank.

6.4.3 MAJOR SYSTEM - OPERATIONAL PHASE

The major system acts as a backup emergency system in case of major storm events with a recurrence interval of greater than 5 years. Its function is to protect the properties and infrastructure from damage and flooding during such events.

The following measures are proposed in terms of the design of the major system:

- All runoff generated by the proposed development during the major system will drain overland towards the western boundary. Any access roads and parking will be shaped to direct the stormwater flow to an attenuation facility and or swales which will dissipate the stormwater runoff.
- The stormwater will be able to discharge naturally along the western boundary of the site to the natural drainage valley. Cognisance will be taken of the future PWV Road reserve located on the western boundary of the site when/if designing any formal stormwater discharge pipes in to this road reserve.

A separate stormwater management report for the site, specifically detailing the design philosophy and calculations of the stormwater runoff will be prepared and submitted to the West Rand District Municipality separately to this report. This report is normally an SDP requirement.

The developer should comply with the National Dust Control Regulations that were promulgated on 1 November 2013 during the construction phase of the project.

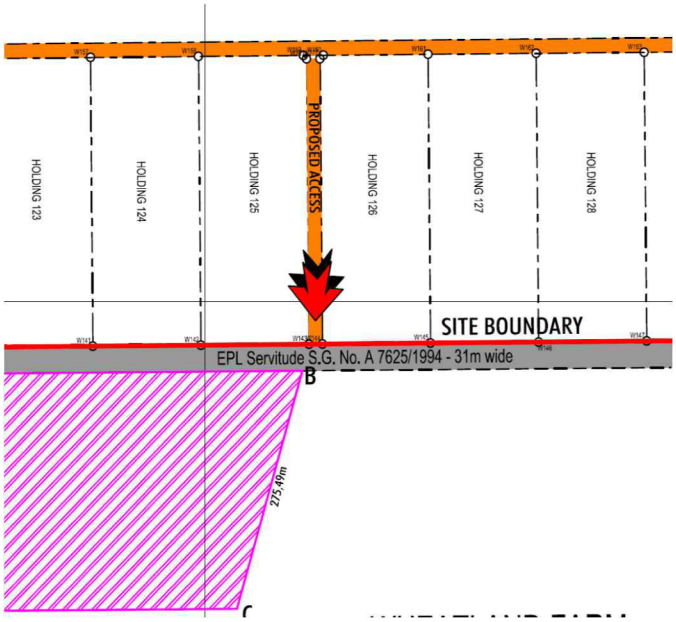
7. ROADS

7.1 EXISTING INFRASTRUCTURE

There is currently no road available on the boundary of the site other than a gravel patrol road along the Eskom Servitude (Servitude No. A 7625/1994) which runs on the northern boundary of the planned site.

A link road has been proposed from Road 3 along an existing ROW servitude between Holding 125 and 126 to the north eastern corner of the site as per sketch below. However the access has been closed

in accordance with the SG diagram 3099/1978 and therefore access cannot be taken from Road 3 as proposed.



A new access road will have to be constructed to run parallel to the Eskom servitude along the northern boundary of Remainder of the farm Wheatlands 260 I.Q from the site to link with Road 6 running in a north to south direction approximately 1km to the east. See attached Site Layout Plan.

7.2 TRAFFIC IMPACT

Given the very low use of the site once it is developed it is not expected that the site will generate more than 10 Peak Hour trips at any given time and the impact on the surrounding road network will be negligible.

During construction phases it will be necessary to provide dust suppression measures on the gravel roads. It is proposed to have water tankers wet the road on a regular basis in order to reduce the dust.

There is sufficient capacity in the surrounding roads network for the proposed development and there are no road upgrades necessary by the development.

7.3 GEOMETRY

7.3.1 STANDARDS

The road infrastructure for the site will be configured in accordance with the Council requirements and it is anticipated that a 4-6m wide graded gravel road would be sufficient to provide the required access to the site.

The gravel road will be coated with Dustlock or any other similar product. Dustlock is a water-based emulsion of modified acrylic polymers suitable for application to areas that require medium to long term dust suppression. It is environmentally friendly and biodegradable. It has no long-term adverse impact on the environment and is safe to handle. It is non-toxic and non-hazardous.

It will be necessary to prepare a full design of the intersection on to Road No. 06 and the appropriate traffic warning signs and road marking will be required.

A wayleave will be required from Council while constructing the intersection.

7.3.2 DESCRIPTION

7.3.2.1 SITE ACCESS

Access to the site will be via a new gravel road constructed along the northern boundary of boundary of Remainder of the farm Wheatlands 260-IQ and running parallel to the current Eskom servitude on the site.

Internally there will be a gravel road servicing the site. Internal roads will also be coated with the same dust suppression solution.

7.3.2.2 PARKING

Minimal parking will be required and it is planned to provide a maximum of 10 designated parking areas on the site which will be shown on the SDP.

7.4 BULK SERVICE CONTRIBUTIONS

As no bulk services will be provided to the site there will not be bulk service contributions applicable to the development.

8. RECOMMENDATIONS & CONCLUSION

8.1 RECOMMENDATIONS

8.1.1 WATER

Water will be provided via a water tanker and modular storage tanks provided on site.
The contractor will have to arrange with the Municipality for a metered water connection at the Finsbury Reservoir site to supply water during construction phase.

The developer will have to arrange with the Municipality for a metered water connection at the Finsbury Reservoir site to top up the water storage modular as and when required during operational phase.

No external water upgrades are required.

8.1.2 SEWER

Sufficient chemical toilets will be provided on site based on the maximum number of contractor available at any point in time during the construction phase. For every 20 labourers it is proposed to have a minimum of 1 chemical toilet. Male and female chemical toilets will be located separately on the site.

During the operational phase, a conservancy tank will be utilized to service the site. The developer should arrange with a Septic Tank Cleaners company to empty the conservancy tank once every 10 day.

8.1.3 SOLID WASTE REMOVAL

A dedicated refuse yard facility at a position internal to the site will be allocated. Refuse will be removed from site by the site operator and disposed of at an approved waste facility as recommended by West Rand District Municipality.

8.1.4 STORMWATER

As the site will remain largely undisturbed apart from a small area for offices and equipment the increase in stormwater runoff will be minimal. It is proposed to provide some swales and berms to reduce run off from the site. These swales and berms will be located at strategic points on the site on completion of the final site plan.

8.1.5 ROADS

Access to the site will be via a graded gravel road to be constructed from Road 6 to the boundary of the site along the northern boundary of the Remainder of the Farm Wheatlands 260-IQ.
The road will be coated with a dust suppression solution to manage the dust in the area.

8.1.6 DUST CONTROL

The developer should comply with the National Dust Control Regulations that were promulgated on 1 November 2013 during the construction phase of the project.
During the construction phase, water tankers will be used to control the dust. During operational phase the dust suppression solution will be used on the roads.

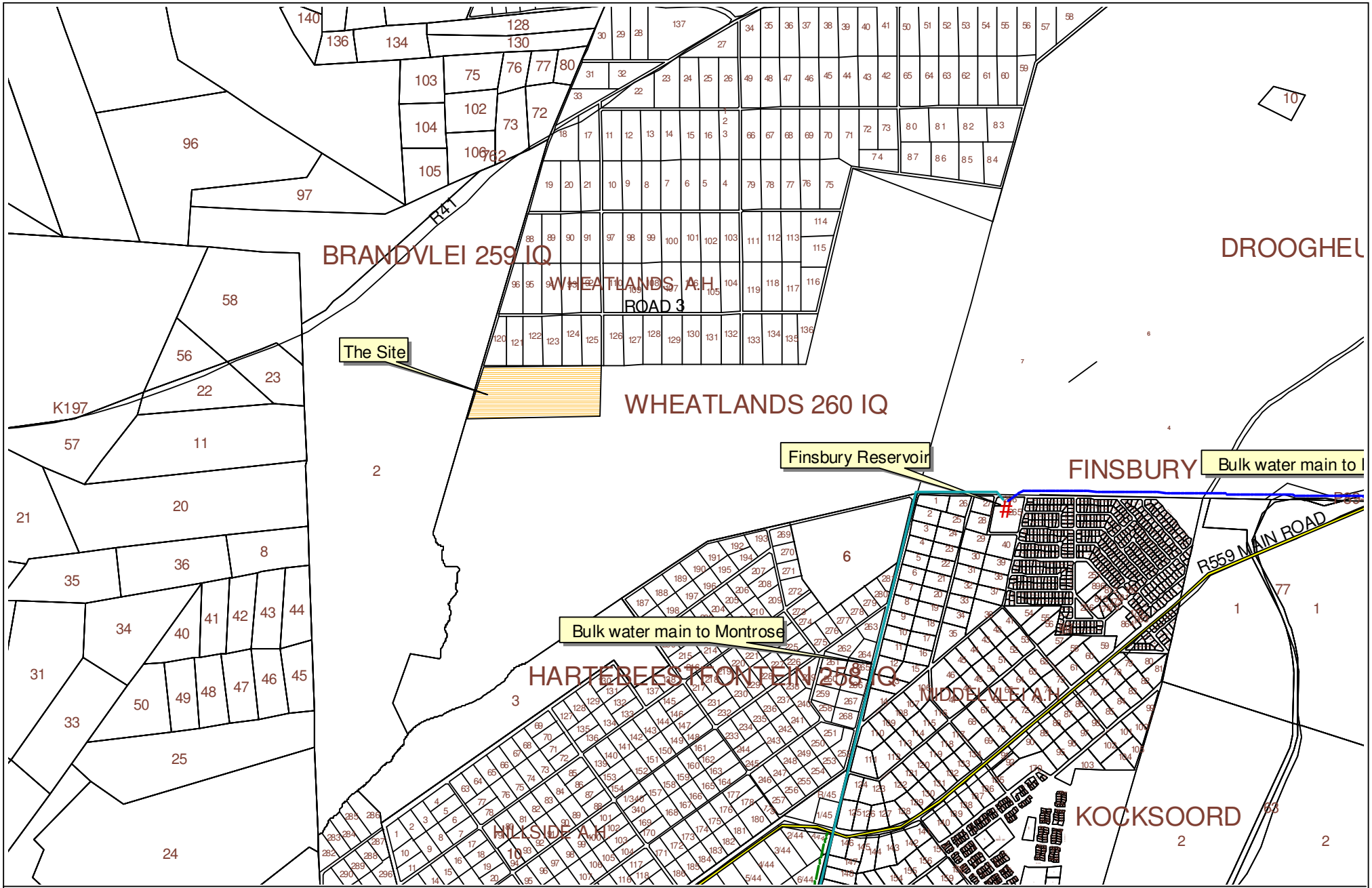
8.2 CONCLUSION

The proposed development will have minimal impact on the council infrastructure and all services on site will be provided by the operator of the site.

Detailed designs will be provided with the submission of any SDP plans to be submitted for approval.
No construction will commence without final approved designs and wayleave from Council.

APPENDIX A

DRAWINGS

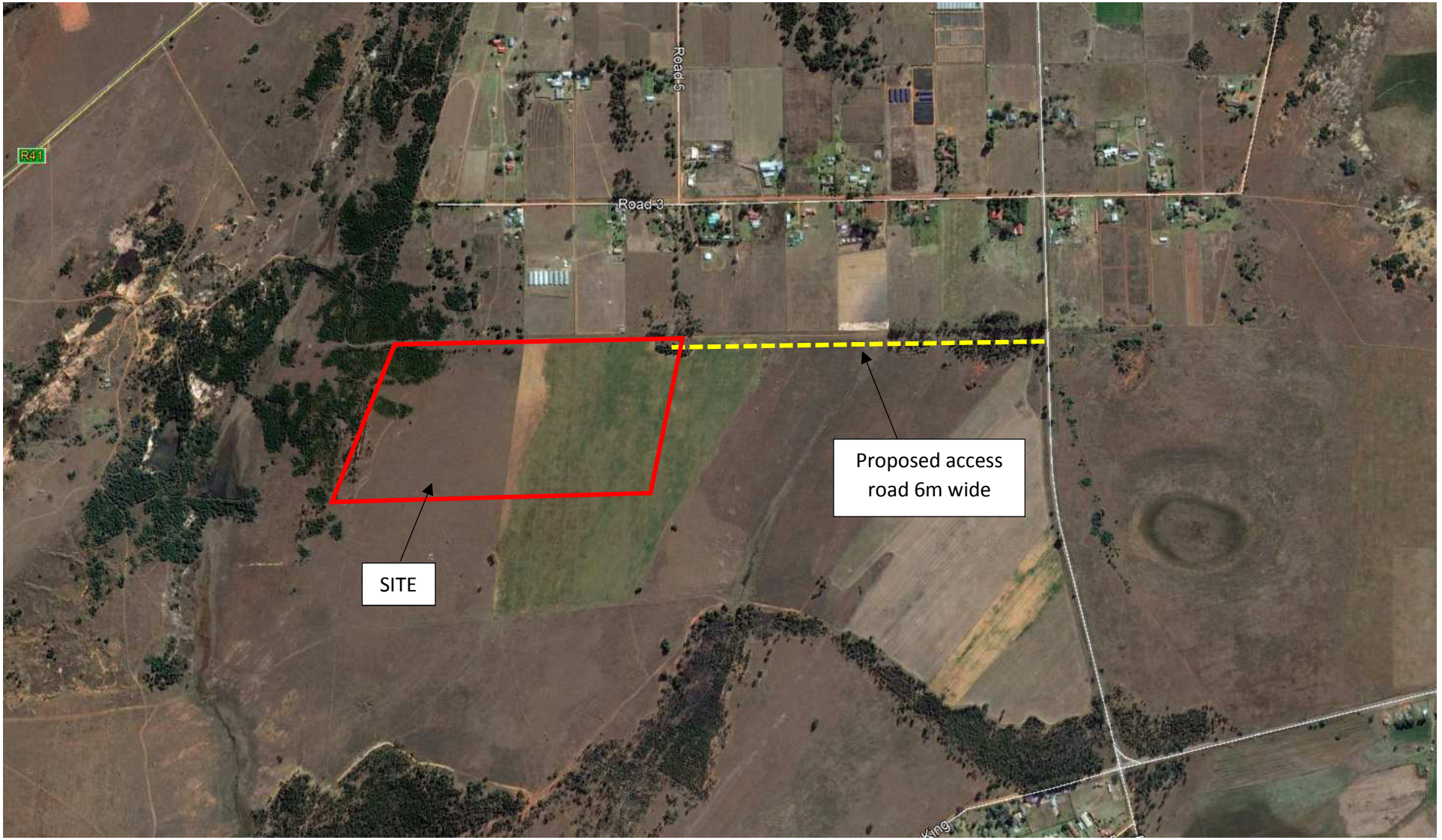


WHEATLANDS SOLAR FARM
LOCALITY PLAN

6884-OSR-01-A-Locality Plan

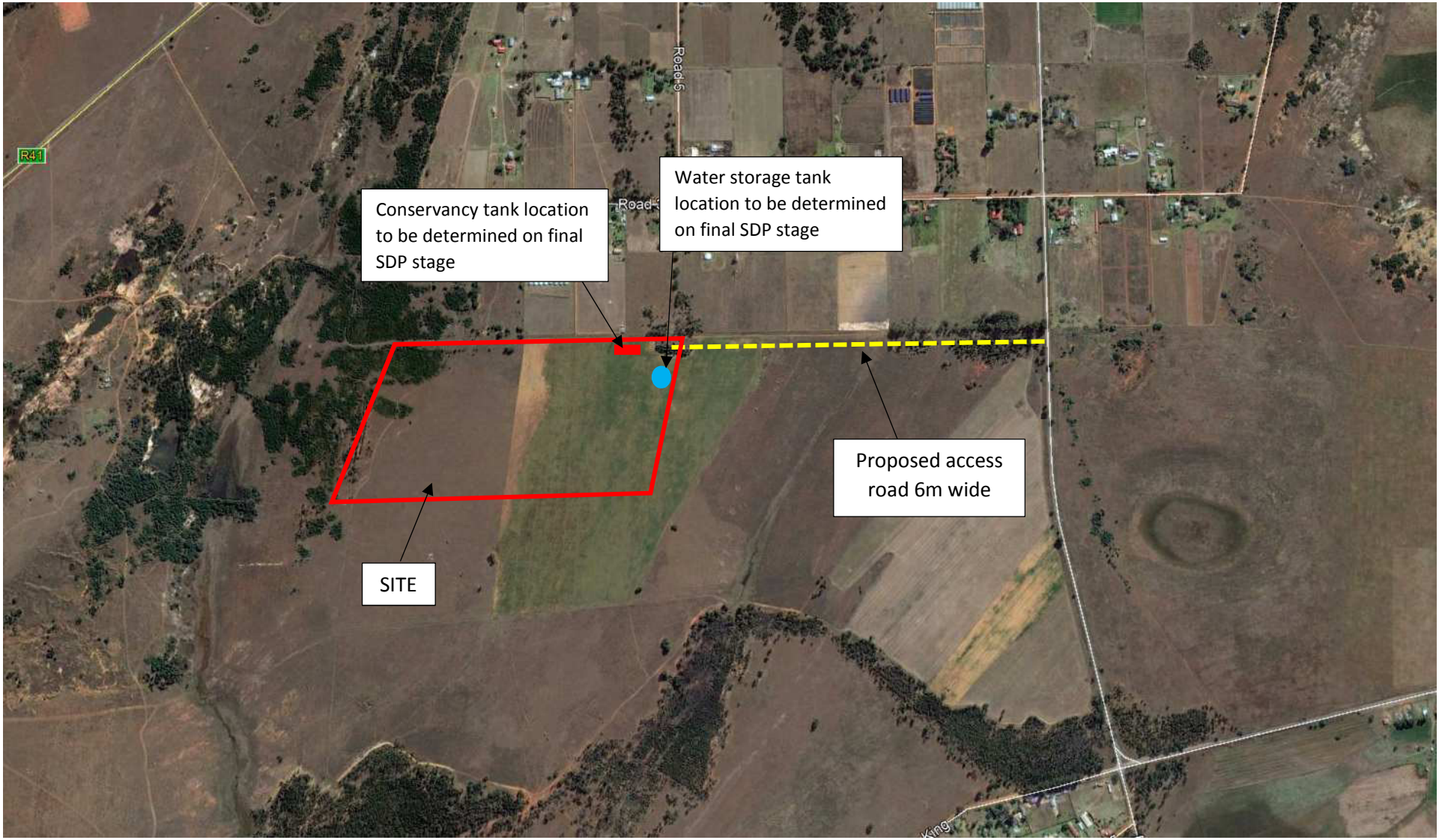
WHEATLANDS SOLAR FARM
AERIAL PHOTOGRAPH

6884-OSR-01-A-Aerial Photograph



WHEATLANDS SOLAR FARM
ACCESS

6884-OSR-01-A-Access



WHEATLANDS SOLAR FARM
SITE LAYOUT PLAN

6884-OSR-01-A-Site Layout Plan

APPENDIX E9

STORMWATER MANAGEMENT REPORT

PROPOSED SOLAR FARM:

PORTION OF THE FARM WHEATLANDS 260IQ

STORMWATER MANAGEMENT REPORT

AUGUST 2017

K&T PROJECT REFERENCE: 6884

REVISION 0

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CONSULTING ENGINEERS
REG. NO. 1966/09839/07
Engineering African Development

Details of this report

Client Name:	SolarReserve SA Management (Pty) Ltd
Client Contact:	Ignatius de Wet
Document Title:	Stormwater Management Report
K&T Project Reference:	6884
File Name:	6884 Wheatlands SWMR.docx

Report Revision Record

Revision	*Date*	*Description*
A	August 2017	Stormwater Management Report

This report has been prepared by Kantey & Templer (Pty) Ltd, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating our General Terms and Conditions of Business and taking account of the resources devoted to it by agreement with the client. We disclaim any responsibility to the client and others in respect of any matters outside the scope of the above.
This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

For and on behalf of Kantey & Templer (Pty) Ltd	
Completed by:	Neil Pinard
Signature(s):	
Reviewed & revised by:	Sean Dickinson
Signature:	
Approved by:	Sean Dickinson
Signature:	

EXECUTIVE SUMMARY

INTRODUCTION

Kantey & Templer Consulting Engineers (K&T) has been appointed by SolarReserve (Pty) Ltd to compile a Stormwater Management Report in support of the proposed establishment of a solar farm facility on a portion of the Farm Wheatlands 260 IQ located within the West Rand District Municipality boundary.
The following was found with regards to Stormwater Management related to the proposed development:

SITE AND STORMWATER

The site has an average slope of 1.7% from east to west and drains in a westerly direction towards the natural drainage valley located approximately 300m to the west of the site boundary.

West Rand District Municipality requires the integration of environmental components with engineering components as part of sustainable catchment management. As the ground cover across the site will remain largely natural and grassed with the exception of the operational facilities the stormwater runoff will not increase significantly over the whole site.

It is proposed incorporate Sustainable Urban Drainage System (SUDS) to control the flow of stormwater. Swales will be constructed on site and an infiltration trench is proposed along the western boundary of the site. It is also proposed to harvest rain by means of a tank to collect water from the prefabricated / containerised O&M building.

Construction Phase
It is proposed to install two rows of hale bales along the western boundary of the site during the construction phase. This will act as a barrier to prevent silt and debris from washing off the site

ECOLOGICAL SYSTEM

The purpose of this storm water management scheme is to reproduce as nearly as possible the hydrological conditions at point of discharge that existed prior to any development, provide for removal of most urban pollutants, and have a neutral to positive impact on the natural and human environment.

- It is proposed to implement Sustainable Urban Drainage System (SUDS) as far as possible on this site.
- Various methods were investigated and the use of swales, rain harvesting and an infiltration trench has been chosen.
- It is proposed to harvest rain by means of a tank to collect water from the prefabricated / containerised O&M building

STORMWATER MANAGEMENT REPORT FOR THE DEVELOPMENT OF A SOLAR FARM ON PORTION OF THE FARM WHEATLANDS 260IQ

CONTENTS PAGE

LIST OF ANNEXURES:

1. INTRODUCTION

1.1 BACKGROUND

Kantey & Templer Consulting Engineers (K&T) has been appointed by SolarReserve (Pty) Ltd to compile a Storwmater Management Report in support of the proposed establishment of a solar farm facility on a portion of the Farm Wheatlands 260 IQ located within the West Rand District Municipality boundary.

The site locality is shown on drawing no. **6884A-SW-01-A: SITE LOCALITY** in **Annexure A.**

1.2 SCOPE OF REPORT

This stormwater management report will indicate how all surface runoff generated as a result of the development (during both construction and operational phases) will be managed (e.g swales/attenuation structures stormwater and flood retention) prior to entering any natural drainage system or wetland.

All stormwater management features should be constructed in a manner that will ensure the continued functioning of the natural landscape, as any changes in surface water flow quality or quantity have significant impacts of the surrounding vegetation that in turn affects associated animal groups

It is proposed to implement **Sustainable Urban Drainage System** (SUDS) for this development situated on a portion of the Farm Wheatlands 260-IQ referred to as **'the site'.**

1.3 PROJECT TEAM

Client:	SolarReserve SA Management (Pty) Ltd
Town planner:	Hunter Theron Town Planners
Civil Engineer:	Kantey & Templer (Pty) Ltd

2. SITE DESCRIPTION

2.1 TOPOGRAPHY & LOCATION

Location:	The site is located on the western portion of the Farm Wheatlands 260IQ which is in turn located due west of the Randfontein CBD and is bound by the R41 to the north with Wheatlands AH located along the northern boundary and Middelvlei AH located to the south.	
Current Land Use Zoning:	Agricultural	
Existing structures:	Undeveloped with farming activities taking place on large areas of the entire Farm portion. The future PWV1 Route is placed alongside the western boundary of the site.	
Level & fall of terrain:	The portion of land being considered for the solar site falls gently from east to west and towards the natural drainage valley located approximately 300m further west of the site. Altitude of approximately 1 719 m to 1 732 m above mean sea level. Approximate gradient is 1.7% across the site.	
Vegetation:	Grasslands with a few scattered shrubs and small trees on western side of the site. The eastern side of the site is ploughed lands currently un-utilised.	
Geology & soil:	A geotechnical report for the larger Wheatlands development has been prepared under a separate cover. No dolomitic conditions are encountered.	
Surrounding Land Use:	North	Small Agricultural Holdings
	East	Farmland and future Wheatlands Township development
	South	Farmland and future Wheatlands Township development
	West	Farmlands and future PWV1 Road reserve.

2.2 PROPOSED ZONING & LAND USE

Proposed Land Use Zoning:	Unchanged still farmlands with a consent use to install a Solar Farm.
Height Zone:	Module structure does not exceed 3m height
Coverage:	32%
Floor Area Ratio (FAR):	64,000m2 solar PV modules on a 200,000m2 land
Density:	32%

3. STORMWATER

There are no existing stormwater networks near the boundaries of the site. The site slopes towards the western boundary and drains towards the natural drainage valley. As the site is currently natural grasslands and ploughed fields there is very little stormwater runoff generated by the site.

West Rand District Municipality requires the integration of environmental components with engineering components as part of sustainable catchment management.

3.1 EXISTING INFRASTRUCTURE

Internal:	None.
External:	None.
Downstream Infrastructure for connection points:	The site currently draining overland.
Upstream ingress runoff from upstream sources:	The site currently draining overland.

4. FLOODLINES

A floodline was determined for the larger Wheatlands area and the site does not fall within the 1:100 year floodline demarcation. The site is thus not impacted by the 1:50 and the 1:100 year flood lines. Therefore, a flood hydrology analysis due to the impact of the 1:50 and the 1:100 year flood lines for the proposed development is unwarranted, as specified by Chapter 14, Part 3 of the Water Act (Act 36 of 1998), as required in terms of the Town Planning and Townships Ordinance (Ordinance 15 of 1986).

5. PREDEVELOPMENT FLOWS

The run-off for the pre-developed site was determined using the **Rational Method** for pre-developed conditions so as to determine the maximum allowable post development discharge for both the 1:5 and 1:25 year storms. The run off calculation is provided in **Annexure B**.

As the ground cover across the site will remain largely natural and grassed with the exception of the operational facilities the stormwater runoff will not increase significantly over the whole site.

It is accepted that any site being developed should retain the difference between the 1:5 Pre-developed flow and the 1:25 post-development flow.

From the Run-off calculations the following is applicable:
1: 5 Pre-development flow = 1070m3
1: 25 Post-development flow = 6009m3
Volume to be retained on site = 4302m3

The volume required to be retained will be managed through swales and soak away “gardens” placed a strategic places throughout the site as included in **Annexure A**

6. PROPOSED SERVICES

6.1 CONSTRUCTION PHASE

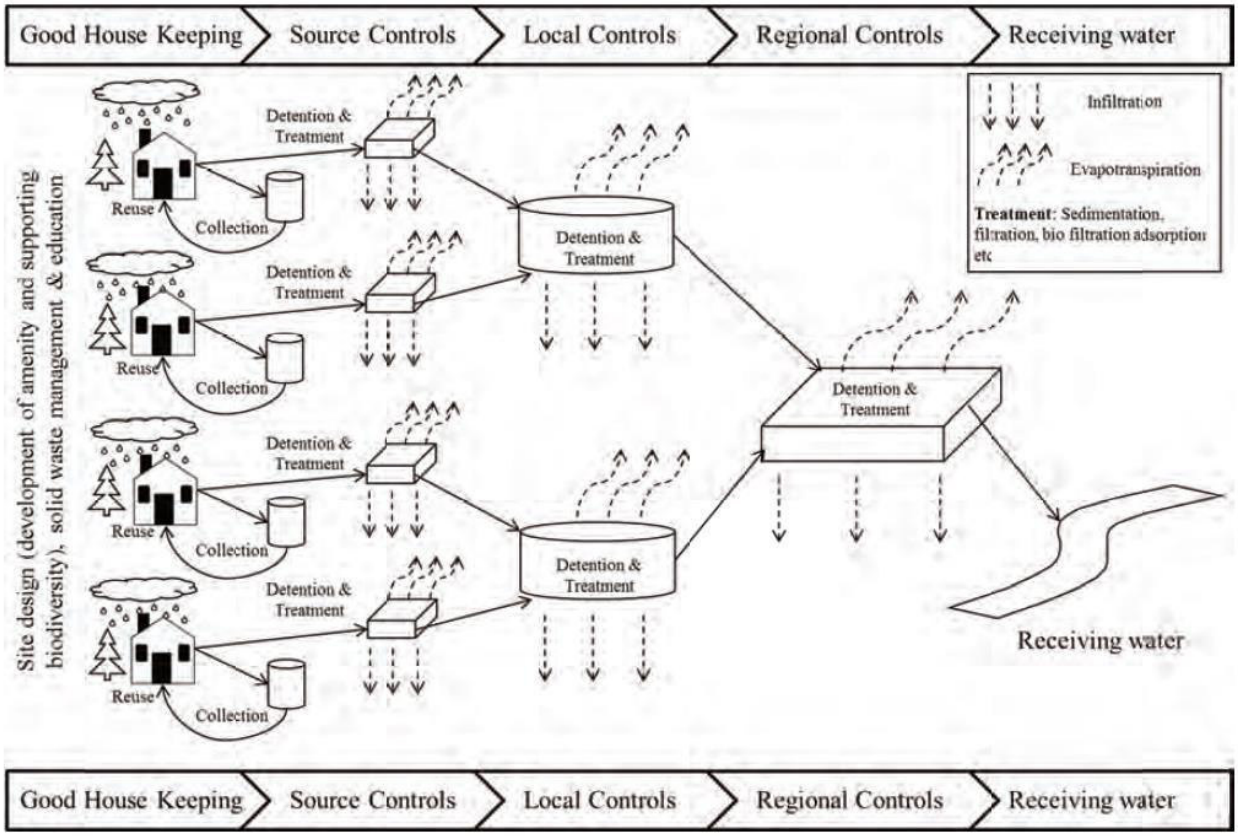
It is proposed to install two rows of hay bales along the western boundary of the site during the construction phase. This will act as a barrier to prevent silt and debris from washing off the site.

On completion of construction, the hay bales will be replaced by a soak away trench or "garden".

6.2 SUSTAINABLE URBAN DRAINAGE SYSTEM (SUDS)

The purpose of this storm water management scheme is to reproduce as nearly as possible the hydrological conditions at point of discharge that existed prior to development, provide for removal of most urban pollutants, and have a neutral to positive impact on the natural and human environment.

This report covers the main objectives of the SUDS by implementing a treatment train and focusing on the local and regional control for this development.



Following the South African Guidelines for Sustainable Urban Drainage Systems the following options were investigated:

Source Controls

- Maintain existing landscape by refraining from stripping topsoil layer to enable water drainage and prevent erosion.
- Rainwater Harvesting refers to the temporary storage and reuse of rooftop and/or surface runoff from prefabricated / containerised buildings.
- Soakaways are usually excavated pits that are packed with course aggregate and other porous media and are used to detain and infiltrate stormwater runoff from a single source.
- The construction of gravel / granular or stone base compacted internal roads that can temporarily channel stormwater runoff.

Local controls

- Filter strips are vegetated areas of land that are used to manage shallow overland stormwater runoff through filtration.
- Swales are shallow grass-lined channels with flat surfaces and sloped sides that are used to convey stormwater from one place to another. They typically remain dry between rainfall events and have a storage capacity to allow for additional infiltration.
- Infiltration trenches are excavated trenches which are lined with a geotextile and backfilled with rock or other relatively large granular material. They are typically designed to receive stormwater runoff from adjoining residential properties.
- Bio-retention / "Rain Gardens" areas are landscaped depressions used to manage stormwater runoff through several natural processes such as filtration, adsorption, biological uptake and sedimentation.
- Sand filters usually comprise of an underground sedimentation chamber connected to a filtration chamber in which stormwater runoff is temporarily stored before being filtered through a sand filter.

Regional controls

- Detention ponds are relatively large depressions that temporarily store stormwater runoff in order to reduce the downstream flood peak.
- Retention ponds also known as 'retention basins' – are formed by excavating below the natural ground level and/or lining the base to retain stormwater runoff.
- Constructed wetlands attempt to mimic the characteristics of natural wetlands through the use of marshy areas and aquatic-resilient plants. They can be aesthetically pleasing and provide a vibrant wildlife habitat.

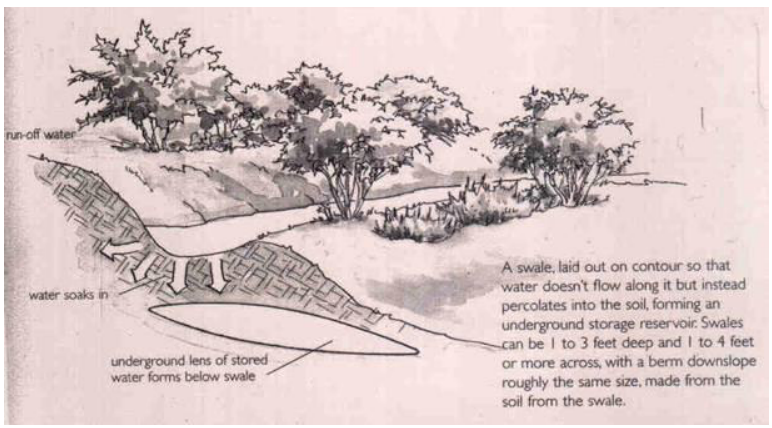
Due the layout of the site, the type of development, topography and available space on site, it is proposed to apply the following SUDS to deal with the stormwater runoff:

Source Controls

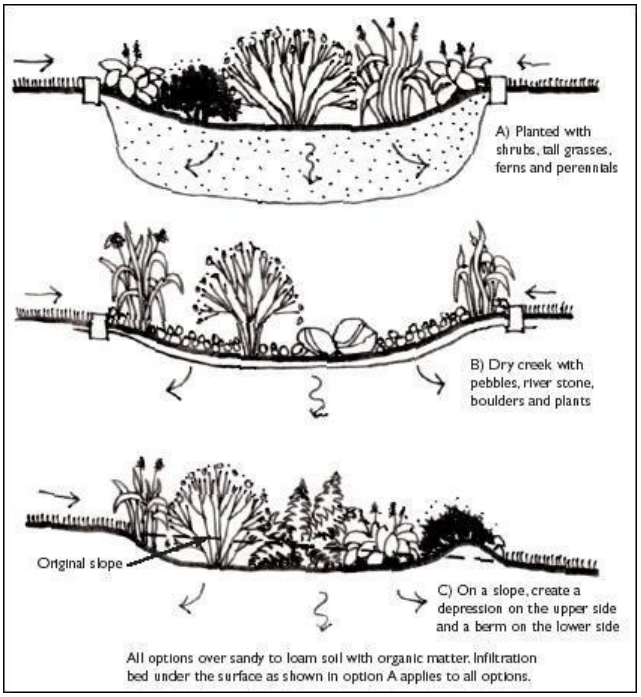
- It is proposed to harvest rain by means of a tank to collect water from the containerised / prefabricated O&M building. This can be used for small scale irrigation or ablution facilities.

Local controls

- Swales are shallow grass-lined channels with flat surfaces and sloped sides that are used to convey stormwater from one place to another. Swales will be constructed to run along the contour so that water is spread along the contour line and allowed to percolate into the soil.



- An infiltration trench will be constructed along the western boundary of the site in order to collect any additional surface runoff.



The natural vegetation of the site will be retained as far as possible. The solar PV modules will cover an area of approximately 62 000m² of the total site which is 197 000m². The PV panels will be mounted above the natural ground. The rain water that falls onto the panels will run off the panels and fall onto the natural ground/vegetation and grass lined swales where it will infiltrate into the soil.

It is proposed to place swales at strategic positions within the site where stormwater run-off will occur to slow down the overland flow and allow time for the water to soak away.

6.3 ROAD DRAINAGE

The internal roads will be constructed gravel roads with a cross fall towards the v-drains which will in turn be directed to swales at the lower points of the road to assist with stormwater drainage. The roads will be coated with a dust suppression solution to manage the dust in the area.

6.4 MINOR SERVICES

The minor system refers to the internal stormwater infrastructure on the site and according to the Dept. of Housing, Guidelines for Human Settlement and Planning, 2000, (Red Book).

The following measures are proposed in terms of the design of the minor system:

- The run-off will be captured by grass lined swales.
- It is proposed to harvest rain by means of a tank to collect water from the containerised / prefabricated O&M building. This can be used for small scale irrigation or ablution facilities.
- The internal roads will be constructed with v-drains channelling the runoff towards the swales
- It is proposed to construct an infiltration trench along the western boundary of the site in order to collect any additional surface runoff.

6.5 MAJOR SYSTEM

The major system acts as a backup emergency system in case of major storm events with a recurrence interval of greater than 5 years. Its function is to protect the properties and infrastructure from damage and flooding during such events.

The following measures are proposed in terms of the design of the major system:

- All runoff generated by the proposed development during the major system will drain overland towards the swales and rain gardens. The access roads and parking will be shaped to direct the stormwater flow to the swales which will dissipate the stormwater runoff.
- All runoff generated by the proposed development during the major system will drain overland towards the western boundary.
- The stormwater will be able to discharge naturally along the western boundary of the site to the natural drainage valley. Cognisance will be taken of the future PWV Road reserve located on the western boundary of the site when/if designing any formal stormwater discharge pipes in to this road reserve.

The layout of the proposed stormwater layout is shown on drawing **6884A-SW-03-A: STORMWATER LAYOUT.**

6.6 DESIGN OF THE STORMWATER MANAGEMENT

SUDS will be incorporated in the stormwater management of the development.

The following design philosophy has been incorporated into the detailed design of the attenuation:

1. Swales are shallow grass lined ditches with flat slopes and are dry between rain events. The swales will have a 300mm depression and will run along the contours to maximise the infiltration.
2. It is proposed to construct an infiltration trench along the western boundary of the site in order to collect any additional surface runoff. Generally it will consist of sand bed, an organic layer, planting soil and plants. It is proposed to have a trench lined with geotextile and back filled with rocks with a 30% void ratio below the planted areas to infiltrate the stormwater runoff
3. It is proposed to harvest rain by means of a tank to collect water from the O&M building.

7. ECOLOGICAL SYSTEM

7.1 ENVIRONMENTAL PLANNING REQUIREMENTS

- The WRDMs Catchment Management Policy includes the statement "Recognises the sustainable catchment management can only be achieved if environmental components of the system are not divorced from engineering components, and where natural and built systems are considered inextricable;"
- The document defines the stormwater system as is "the ecological system comprising the network of water courses and riparian zones that provide ecological linkages within the metropolitan area including water quality management ponds." The following three interlinked systems are identified:
  - Minor system
  - Major system
  - Environmental system

- In terms of stormwater runoff management, the document requires that four interrelated aspects need to be considered, namely:
  - Peak discharge
  - Discharge volume
  - Runoff frequency
  - Runoff water quality

- It also states that "appropriate water quality management measures, eg. 'Water Sensitive Urban Design' (WSUD), need to be identified and implemented for each catchment". In terms of land development, it stipulates "The quality of stormwater runoff from the proposed land developments shall be at least as good as runoff form the property before development. A range of stormwater quality improvement devices are available and the applicant shall submit details of how prevention and/or removal of contaminants from stormwater runoff will be achieved.
- The document further requires that "Construction site runoff should be such that no sediment laden or otherwise polluted runoff leaves the property up to the 2 year recurrence interval of any duration".
- The council requires the **integration** of environmental components with engineering components as part of **sustainable** catchment management.
- The document indicates that minor, major and **environmental systems** be interlinked to form an ecological system that prioritises **water quality management**.
- **Peak discharge, Discharge Volume, Runoff frequency** and water quality are to be considered during stormwater runoff management.
- The council requires that **water quality** preservation measures be implemented for surface runoff and attenuated stormwater.

7.2 DESIGN PARAMETERS

7.2.1 INTRODUCTION

The design principles and the specific SUDS objectives are to improve the quality of stormwater runoff, control quantity and rate of stormwater and to encourage natural ground water recharge. The following SUDS are proposed to be used on site:

- Grassed lined swales are proposed over the site to run along the PV panels to capture all runoff from the panels.

- Infiltration trench along the western boundary to collect any additional runoff.
- Install water tanks to collect the water from O&M building rooftops in order to re-use the water for irrigation.
- Both swales and infiltration trenches will allow for sedimentation and vegetation to be established.

8. CONCLUSION

Due to the site being used for solar panels, a Sustainable Urban Drainage Systems will be implemented as far as possible. Due to the nature of the development, it is recommended to retain the natural vegetation as far as possible. Stormwater can further be managed by means swales, infiltration trench and rain harvesting from the O&M building.

Provided the proposed infrastructure mentioned in this report is constructed, the runoff produced by this development will be well managed. The development should be supported by the local authority as all measures have been taken to ensure that the stormwater is managed in a safe manner and does not negatively impact the surrounding environment.

APPENDIX A

DRAWINGS

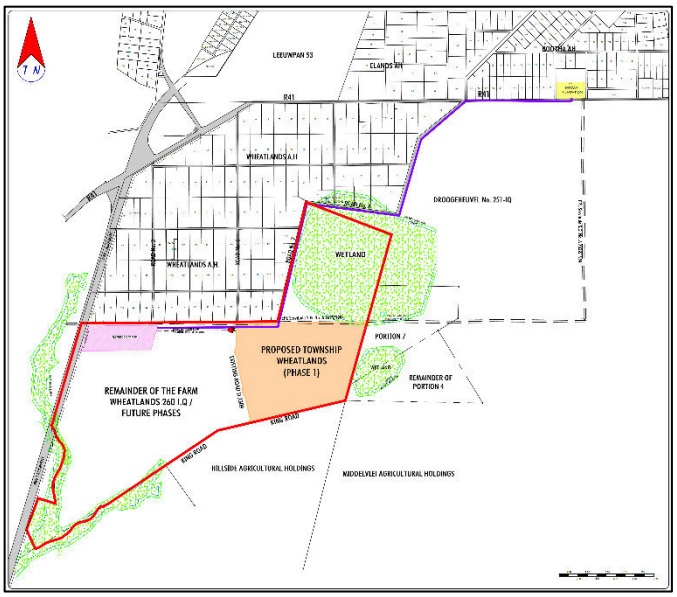
6884 - SW-01-A – Locality Plan
6884 - SW-03-A –Stormwater Layout

APPENDIX B

RUNOFF CALCULATIONS

APPENDIX E10

ELECTRICAL ENGINEERING SERVICES REPORT



WHEATLANDS PV - CONSENT USE APPLICATION

ELECTRICAL ENGINEERING SERVICES REPORT (REV3)

PROJECT REF. NO. : PE0067

COMPILED FOR:

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Date	:	01 August 2017
Project Team	:	Author/s: Johan Sadie (JHS), Pr. Eng (Electrical)
		Reviewer: Dries Louw (AWSL), Pr. Eng (Electrical)
Copies Issued to	:	SolarReserve SA Management (Pty) Ltd (1x Electronic)
		Hunter Theron Inc. (1x Electronic)

Document Revisions

Version	Summary of Amendments	Authors	Reviewers	Date
Rev0	Report issued for Client Comment	JHS	AWSL	2017-03-31
Rev1	Report issued for Client Comment	JHS	AWSL	2017-05-31
Rev2	Report updated to reflect short, long term options	JHS	AWSL	2017-08-01
Rev3	Report updated to reflect line route through wetland	JHS	AWSL	2017-08-02

EXECUTIVE SUMMARY

This report outlines the possible intake points for the proposed Wheatlands PV - Consent Use Application project, gives some alternatives in terms of the connection options (overhead lines or underground cables).

The report does not address any Wheeling Agreements.

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DISCLAIMER

TABLE OF CONTENTS

GLOSSARY OF TERMS AND ABBREVIATIONS

3C	Three core
Al	Aluminium
BDMD	Before Diversity Maximum Demand
Cu	Copper
kVA	kilo Volt Ampere
kV	kilo Volt
LM	Local Municipality
MV	Medium Voltage
SS	Substation

1. DEVELOPMENT INFORMATION

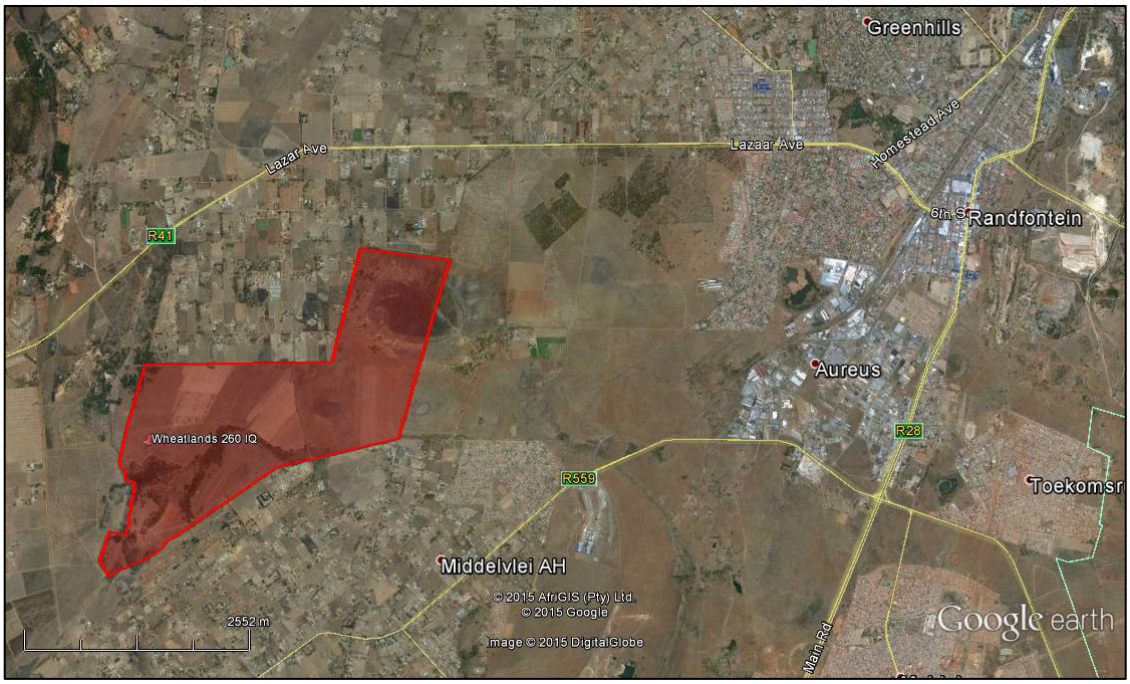
1.1 DEVELOPER

The developer is SolarReserve SA Management (Pty) Ltd.

Physical Address	:	159 Rivonia Road, Sinoteel Plaza, Office 11C SANDTON 2196
Tel No.	:	+27 (0)11 582 6894
Postal Address	:	Postnet Suite 55, Private Bag X9 BENMORE 2010

1.2 LOCALITY OF THE PROPERTY

The Wheatlands 260 IQ property is located to the west of Randfontein town (also north of the Middelvlei AH), to the south of Lazar Avenue (R44) and to the north of the R559 and is situated on the farm Wheatlands 260 IQ, see Picture 1.1 below.



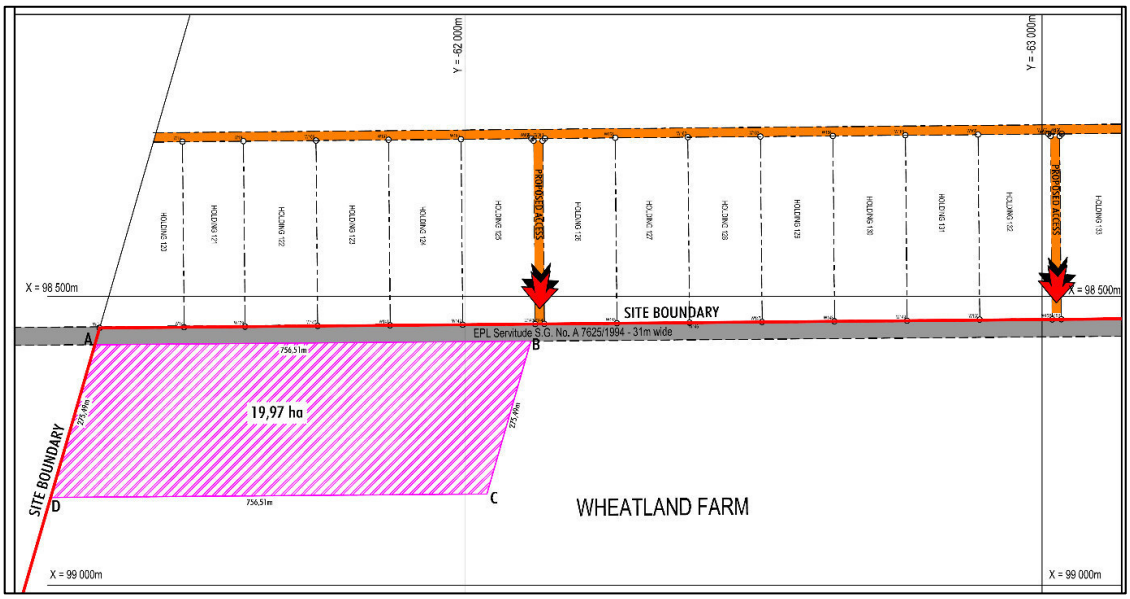
Picture 1.1 - Locality map (courtesy of Google Earth)

1.3 EXISTING LAND USE

The existing land use is Agricultural.

1.4 LOCALITY OF THE PROPOSED PV PLANT

The locality of the Wheatlands PV - Consent Use Application project is as indicated on the Drawing 1.2 below.



Drawing 1.2 - Proposed Site (courtesy of Hunter Theron Inc.)

1.5 TOWN PLANNING APPLICATION

A consent use application is being prepared by the town planners, Hunter Theron Inc.

2. STATUS QUO OF EXISTING BULK ELECTRICAL SERVICES

2.1 SUPPLY AUTHORITY

The proposed development falls within the Licensed Area of Supply of Rand West City Local Municipality.

A meeting was held with representative from Rand West City LM to obtain inputs with regards to system capacity as well as other technical and non-technical requirements.

Additional information was requested from Lyon & Partners (master planning consultants for Rand West City LM) and their feedback is included in his report where applicable.

2.2 PV SUPPLY CAPACITY

2.2.1 Bulk Supply Capacity

The bulk supply capacity generated by the Wheatlands PV - Consent Use Application plant is 9.3MW AC at 11kV.

2.3 EXISTING INFRASTRUCTURE

2.3.1 Existing Switching Station

The client requested that exporting of the bulk supply capacity to the Finsbury switching station be investigated.

Based on the fact that this is only a switching station and there is no transformers installed or space allowance to change this switching station to a substation, this option is not feasible and will not be further discussed in this report.

2.3.2 Existing Intake Substations

Currently the Rand West City LM has a total of six intake substations from Eskom, namely Drowell, Industries, Middelvlei/Lafarge, Mohlakeng, Randfontein Munic and Westergloor. The idea is to export the bulk supply capacity generated by the Wheatlands PV - Consent Use Application plant to one of these substations and from there the capacity can be used within that substations local distribution network. At this stage it is not anticipated that this capacity will be exported to Eskom as there is no such agreement between Rand West City LM and Eskom.

The substations details are as listed below:

Substation	Voltage	Installed Transfomer Capacity	Notified Maximum Demand	Actual Maximum Demand	Spare Capacity
Drowell	132/11/6.6kV	2 x 20 MVA	25 MVA	22 MVA	No firm transformer capacity, transformer failure may be catastopic
Industries	44/6.6kV	30 MVA	19 MVA	16 MVA	None or very little firm transformer capacity
Middlevlei / Lafarge	132/6.6kV	1 x 20 MVA	20 MVA	8 MVA	12 MVA
Mohlakeng	44/11kV	2x 10MVA	18 MVA	17.5 MVA	No firm transformer capacity, transformer failure will be catastopic
Randfontein Munic	44/6.6kV	30 MVA	16.5 MVA	15 MVA	None or very little firm transformer capacity
Westergloor	44/6.6kV	2x 10MVA	13.2 MVA	12.5 MVA	No firm transformer capacity, transformer failure may be catastopic

The following must be noted in terms of the existing substations:

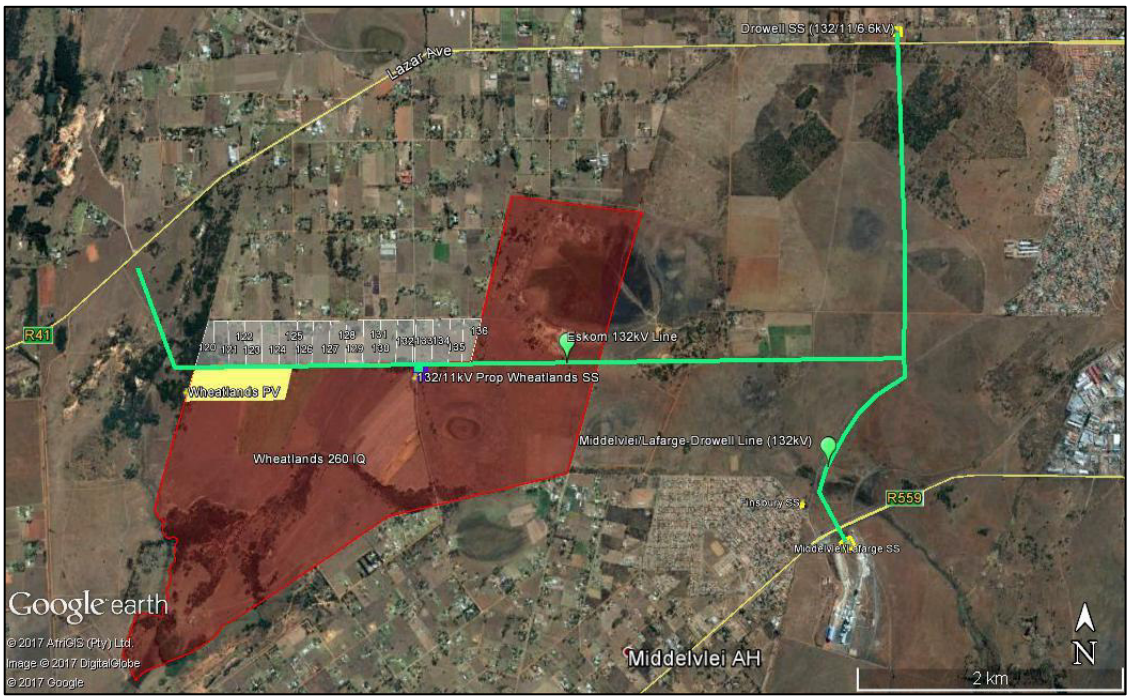
- The Drowell, Middelvlei/Lafarge and Mohlakeng substations are the nearest to the proposed development
  - The Middelvlei/Lafarge substation is a dedicated substation for Lafarge and is therefore not an option;
  - Due to the position of the Mohlakeng substation, at least 9.5km from the proposed Wheatlands PV - Consent Use Application site, this substation will not be further investigated at this stage;
  - Based on the above, Drowell Substation remains the only viable Short Term option and will be discussed further as part of this report.

2.3.3 Proposed Intake Substation/s

As part of the new Rand West City LM Electrical Masterplan, a new 132/11kV, 40MVA firm capacity, Wheatlands Intake Substation from Eskom is planned below the existing 132kV Eskom overhead line that is constructed from east to west through the Wheatlands 260-IQ site. The time frame for the approvals, planning and construction of a substation is approximately 36 to 60 months when it has been included in the Eskom roll-out plan, as this is not the case, no realistic estimated time frame is available. This is then a Long Term solution for the connection of the Wheatlands PV - Consent Use Application plant to the Rand West City LM electrical network and as no time frames are available, this option will not be further discussed as part of this report.

2.3.4 Locality of Existing Drowell SS and Proposed Wheatlands SS

The google earth drawing below (Drawing 2.1) indicates the position of the Drowell SS as well as the approximate position of the proposed Wheatlands SS as well as the existing Eskom 132kV lines in relation to the Wheatlands PV - Consent Use Application site.



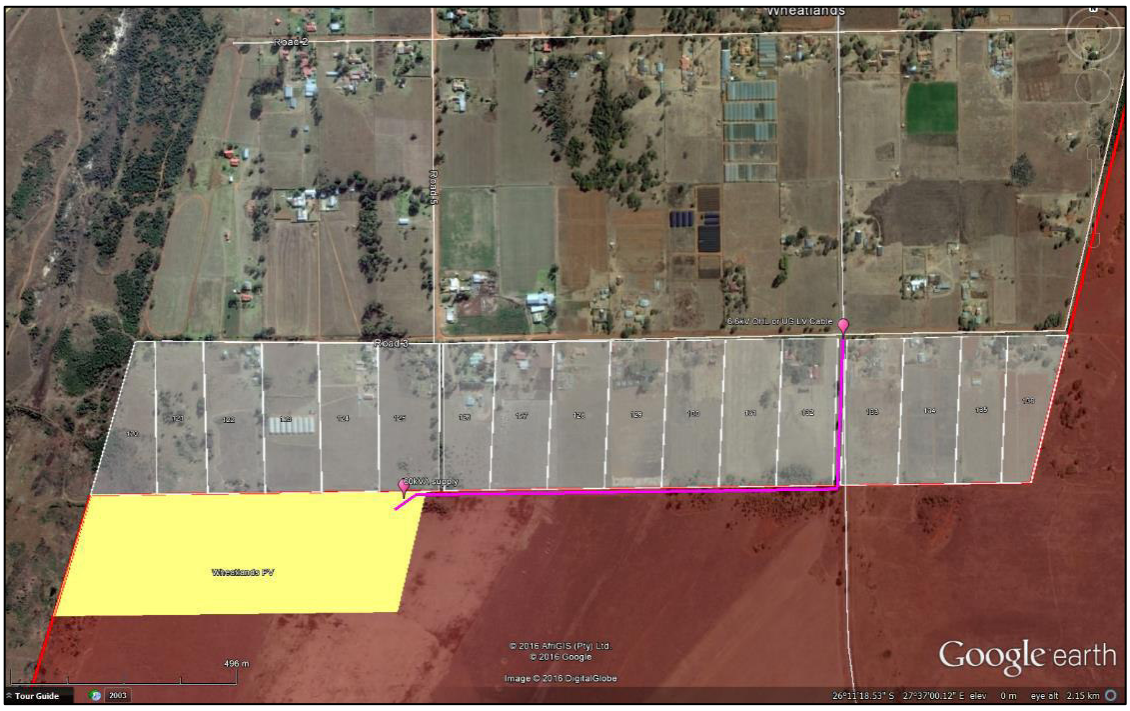
Drawing 2.1 - Drowell SS and Proposed Wheatlands SS locality (courtesy of Google Earth)

3. REQUIRED NEW INFRASTRUCTURE AND PROPOSED UPGRADES TO EXISTING INFRASTRUCTURE

3.1 REQUIRED BULK CONNECTION POINT

The bulk connection point required for the Wheatlands PV - Consent Use Application plant is 60kVA, three phase (415V).

It was indicated by Rand West City LM that existing capacity for this connection will be available from the existing 6.6kV network in Road 6. Based on the layout plans of the holdings to the North of the proposed Wheatlands PV - Consent Use Application site, there is as thoroughfare between Holding 132 and Holding 133, see Drawing 3.1 below.



Drawing 3.1 - Proposed Connection Point (courtesy of Google Earth)

3.2 PROPOSED UPGRADES TO EXISTING INFRASTRUCTURE

In order to connect the bulk supply capacity generated by the Wheatlands PV - Consent Use Application plant to the Drowell Substation, loss calculations were completed to determine the power distribution philosophy.

3.2.1 Loss Calculation

To determine the overhead (OH) line conductor required to transfer the 9.3MW capacity from the Wheatlands PV - Consent Use Application plant site to the Drowell substation, a ReticMaster voltage drop calculation was completed, the results are as listed below:

a. Calc 1 - 11kV SolarReserve PV SS to Drowell SS, 7.2km, Kingbird ACSR OH line, **VD = ±8.5%**
b. Calc 2 - 11kV SolarReserve PV SS to Drowell SS, 7.2km, 2x Kingbird ACSR OH lines, **VD = ±3.0%**
c. Calc 3 - 11kV SolarReserve PV SS to Drowell SS, 5.2km, Kingbird ACSR OH line, **VD = ±5.2%**
d. Calc 4 - 11kV SolarReserve PV SS to Drowell SS, 5.2km, 2x Kingbird ACSR OH lines, **VD = ±1.7%**
e. Calc 5 - 33kV SolarReserve PV SS to Drowell SS, 7.2km, Hare ACSR OH line, **VD = ±2.0%**
f. Calc 6 - 33kV SolarReserve PV SS to Drowell SS, 7.2km, 2x Hare ACSR OH lines, **VD = ±1.0%**
g. Calc 7 - 33kV SolarReserve PV SS to Drowell SS, 5.2km, Hare ACSR OH line, **VD = ±1.4%**
h. Calc 8 - 33kV SolarReserve PV SS to Drowell SS, 5.2km, 2x Hare ACSR OH lines, **VD = ±0.7%**

Based on the above information, and if the Client metering point is at the Drowell SS it is evident that the preferred option will be the 33kV infrastructure where the voltage drop would be less than 1%. Further investigations and calculations would be necessary to finalise the conductor sizing based on optimal costing of the overhead and lifetime least cost analysis. The calculation proved that a Hare ACSR conductor could be used if two lines can be constructed.

It was also indicated that the 5.2km route would not be feasible as the site would encroach into an existing wetland and neighbouring developers land, this option will thus not be discussed any further.

The client has indicated that they will prefer one of the 11kV line route options (this is in contradiction to the best option calculated based on losses) as they will negotiate the metering

point at the Wheatlands PV - Consent Use Application plant's step-up transformer as the edge of the site. This option has not been discussed with the Rand West City LM as there is no knowledge of such developments within the municipality.

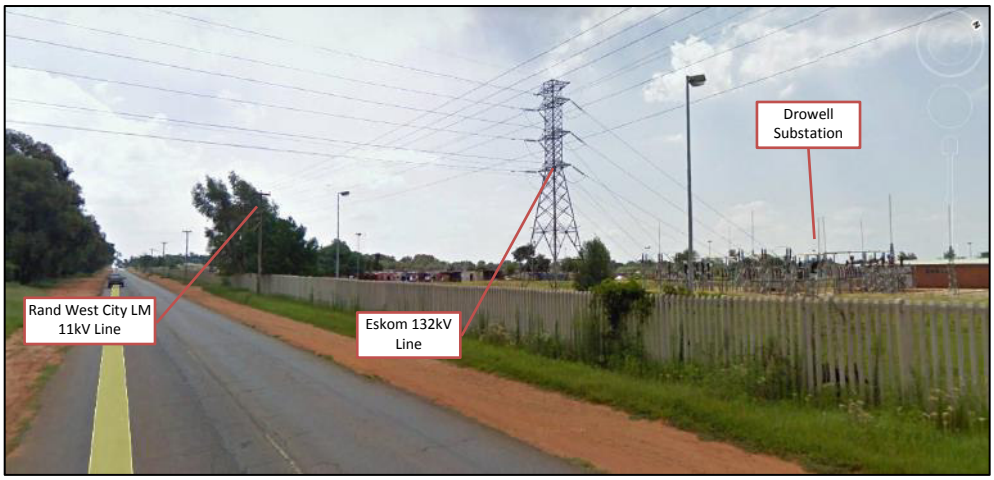
In essence, the following infrastructure needs to be constructed, installed or upgraded as discussed in the paragraphs below.

3.2.2 Drowell Substation

- The existing control building needs to be enlarged (extended);

Drowell Substation and Lazar Avenue

Below is a picture (Picture 3.2) indicating the Drowell SS and the crossing of the Eskom 132kV overhead line crossing at Lazar Avenue (R41). An existing Rand West City LM 11kV overhead line is also visible on the Northern side of Lazar Avenue.



Picture 3.2 - Drowell Sub, Services Crossing & Along Lazar Ave (courtesy of Google Earth)

3.3 PROPOSED NEW INFRASTRUCTURE

In order to connect the bulk supply capacity generated by the Wheatlands PV - Consent Use Application plant to the Drowell Substation, the following infrastructure needs to be constructed:

3.3.1 Drowell Substation

- Install two incomer panels (double bus);
- Install one bus coupler panel (double bus);
- Install telemetry (if applicable);

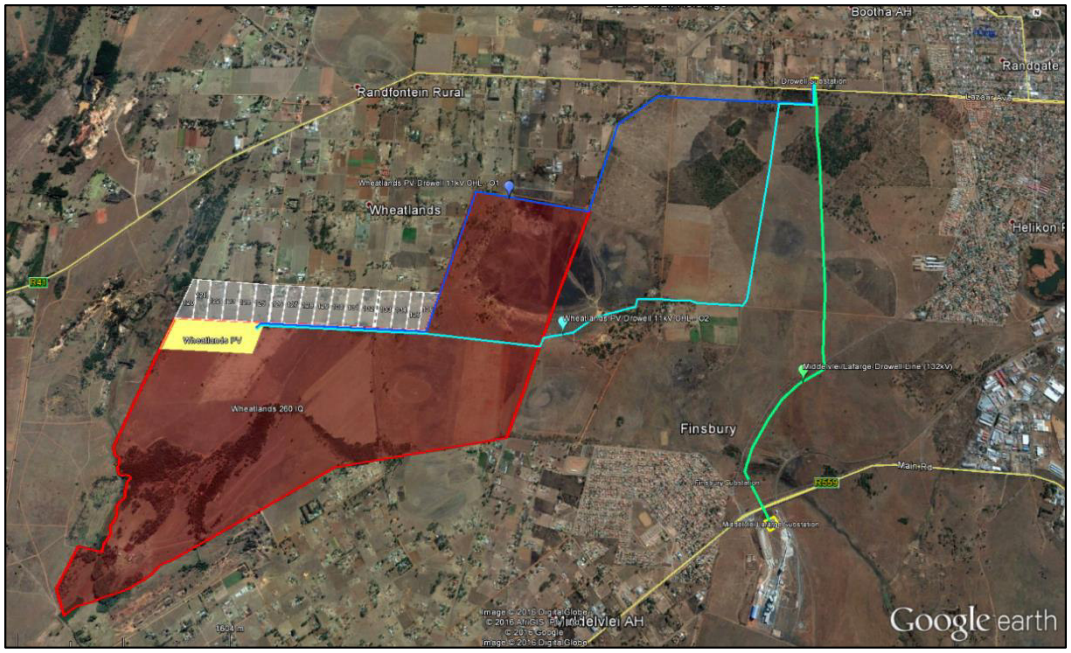
3.3.2 Overhead Line

- Overhead line from Wheatlands PV - Consent Use Application substation to Drowell SS, based on the following:
  - Conductor, ACSR, supply authority alternatives:
    - Hare (360A, 6.8MVA @11kV), single circuit;
    - Hare (360A, 13.7MVA @11kV), double circuit (for firm supply);

- Bear (650A, 12.4MVA @11kV), single circuit - proposed as it will be able to transfer sufficient capacity at the lowest cost;
- Kingbird (710A, 13.5MVA @11kV), single circuit (for firm supply);
- A 22m (11m+11m) servitude for a single line or 36m (11m+14m+11m) servitude for dual line will be required (either as part of an existing road reserve with building restrictions) or a completely separate servitude where no road reserve is available or where there is not sufficient clearance in an existing road reserve.

- Concrete poles, stays and struts:
  - 12m poles, stays, struts for normal use;
  - 13m poles for road crossings;
- Pole top configuration:
  - Staggered vertical
- Pole spacing:
  - 60m to 80m spacing is preferred

- Proposed 11kV Overhead Line Routes
  - Two options are indicated at this stage, as indicated on the Drawing 3.3 below.
    - Option 1: The dark blue line, a total of approximately 7.0km
    - Option 2: The light blue line, a total of approximately 7.1km



Drawing 3.3 - Proposed 11kV Overhead Line Routes (courtesy of Google Earth)

  - The preferred line route is Option 1. The Option 2 line route is through neighbouring developments where the required servitudes may prove difficult to obtain.

3.3.3 Overhead Line - Excavation through Wetland

The excavation of the holes for the concrete poles will be completed by using a TLB with a small bucket (600mm wide) to minimise the impact on the environment. Holes will be 2.0m deep and

1m x 1m wide. If the area does not allow for a TLB to be used, hand excavations wil be done. All the sides of the excavated holes will be protected from falling in by shoring. The backfilling of the holes will be augmented with the addition of concrete to ensure that the poles stay upright after installation. The line route through the wetland will be approximately 900 meters, based on 60m spacing between poles, it is estimated that 15 poles will be installed through the wetland (±30m^3 of excavations).

No general vegetation clearing will be done, although vegetation may be mowed prior to installation. Walking and driving on the site may lead to paths forming in the vegetation, this will be minimised as far as possible.

4. CONTRIBUTIONS PAYABLE

4.1 BULK CONTRIBUTIONS

In terms of the current Rand West City LM tariff policy, bulk contributions of R 2000.22/kVA (inclusive of VAT) is applicable to new customers.

As the Wheatlands PV - Consent Use Application project will export electricity to the Rand West City LM, in our opinion, there should be no bulk contributions payable. As this would be the first project of this nature for Rand West City LM, there is no final clarity on this matter. The estimated project does not include for any such costs.

5. PROJECT COST ESTIMATE

In terms of this project, the items as listed in the spreadsheet below will be payable.

Description	Unit	Qty	Rate	Total Cost
Drowell Substation				
Preliminary & General	Sum	±10.0%	R 8 577 000.00	R 857 700.00
Drowell Control Room - Extension, Earthing	m²	60	R 12 000.00	R 720 000.00
Main Incomer Panel c/w protection relay	No	2	R 401 000.00	R 802 000.00
Busbar Coupler c/w protection relay	No	1	R 394 000.00	R 394 000.00
Delivery, installation & commissioning of panels	No	3	R 20 000.00	R 60 000.00
Motorisation of existing panels	No	2	R 50 000.00	R 100 000.00
Telemetry, interlocking, GSM (including Eskom)	No	1	R 500 000.00	R 500 000.00
Maintenance tools	No	1	R 45 000.00	R 45 000.00
11kV Overhead Line - Bear Conductor (dual line)				
Concrete poles (12m/13m)	m	15000	R 365.00	R 5 475 000.00
Connection Point				
Municipal connection (3 phase)	No	60kVA	R 2 000.22	R 120 013.20
Municipal connection (3 phase) - construction	No	1	R 360 000.00	R 360 000.00
Subtotal A				**R 9 433 713.20**
Contingencies	Sum	±10.0%		R 944 000.00
Subtotal B				**R 10 377 713.20**
Professional Fees				
Professional Fees	Sum	±10.0%		R 1 037 800.00
Admin and Disbursements	Sum	±2.5%		R 259 500.00
Subtotal C				**R 1 297 300.00**
Subtotal D (B + C)				**R 11 675 013.20**
Add: VAT @		14.0%		R 1 634 501.85
Total Estimated Project Value				**R 13 309 515.05**

Notes:

- If the existing panels can't be motorised, an additional two panels may be required. This has not been included in the estimate above.
- Allowance has been made for a dual 11kV overhead line to ensure a firm supply.
- The municipal connection (3 phase) cost estimate will be based on actual costs once a formal application has been made to the Rand West City LM.

6. WAYLEAVES

The following wayleaves will be required and will be applied for before construction at these areas will commence:

- Where the proposed overhead line route/s cross the R41 road reserve;
- Where the proposed overhead line route/s cross the existing 132kV Eskom line and line servitude;
- For all existing townships and road reserves where the proposed overhead lines will be installed;
- Wayleaves will be requested from all relevant supply authorities and services providers.

7. RECOMMENDATION

The following is recommended in terms of this development:

- That the Rand West City LM be formally approached in terms of a possible Wheeling Agreement as this has never been implemented and as such there is no current methodology or draft agreement that can be used.
- That a formal application for the connection point be forwarded to the Rand West City LM to firm up on the connection cost payable

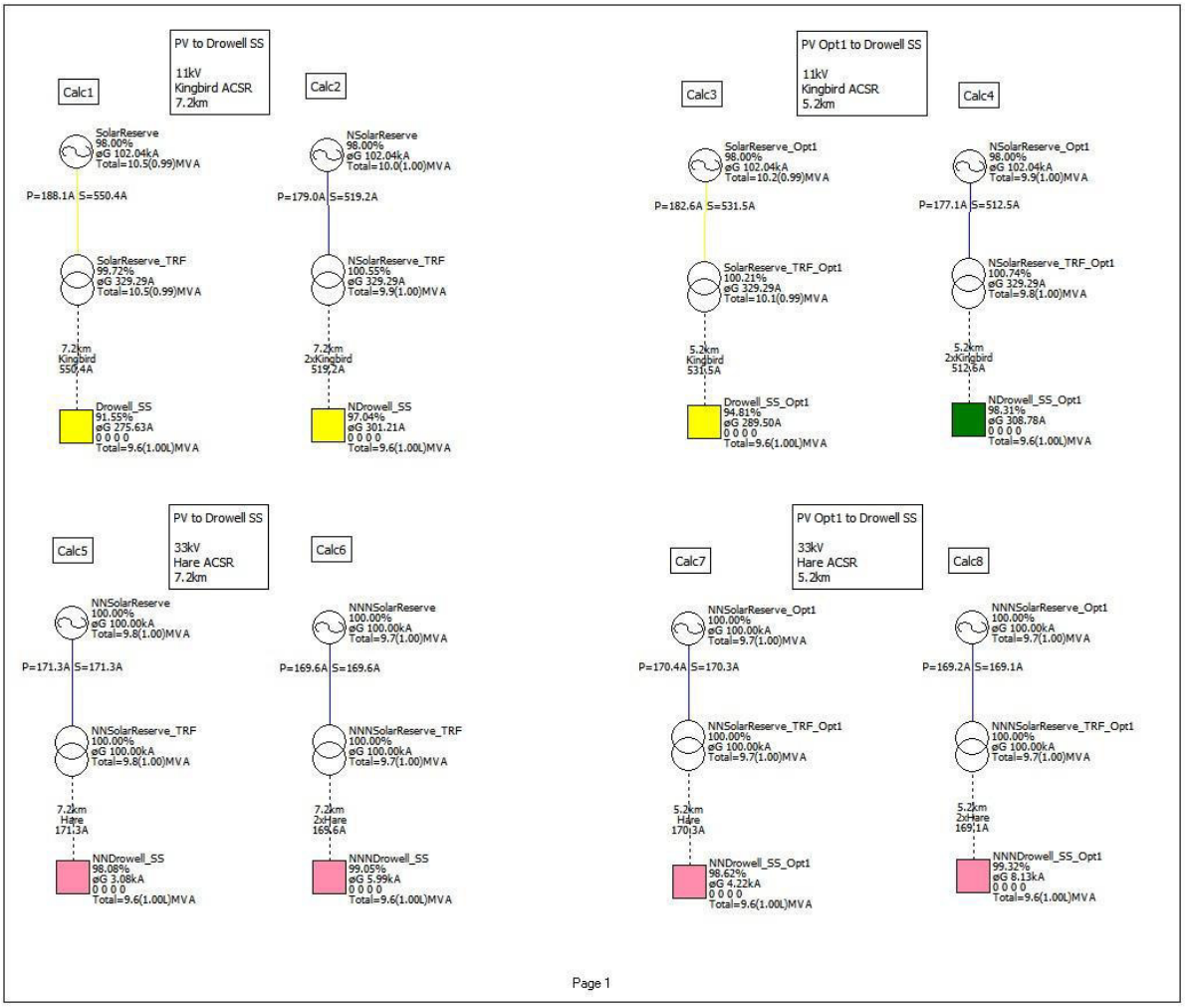
8. TIME FRAMES

Indicative time frames are listed below to give an indication of prospective development time frames:

Application to Rand West City LM for connection point, feedback	8 - 12 weeks
Planning and Construction of Bulk Infrastructure	12 - 18 months

Appendix A

Voltage Drop Calculations


PV to Drowell SS
11kV
Kingbird ACSR
7.2km
Calc1
SolarReserve
98.00%
øG 102.04kA
Total=10.5(0.99)MVA
P=188.1A S=550.4A
SolarReserve_TRF
99.72%
øG 329.29A
Total=10.5(0.99)MVA
7.2km
Kingbird
550.4A
Drowell_SS
91.55%
øG 275.63A
0 0 0 0
Total=9.6(1.00L)MVA
Calc2
NSolarReserve
98.00%
øG 102.04kA
Total=10.0(1.00)MVA
P=179.0A S=519.2A
NSolarReserve_TRF
100.55%
øG 329.29A
Total=9.9(1.00)MVA
7.2km
2xKingbird
519.2A
NDrowell_SS
97.04%
øG 301.21A
0 0 0 0
Total=9.6(1.00L)MVA
PV Opt1 to Drowell SS
11kV
Kingbird ACSR
5.2km
Calc3
SolarReserve_Opt1
98.00%
øG 102.04kA
Total=10.2(0.99)MVA
P=182.6A S=531.5A
SolarReserve_TRF_Opt1
100.21%
øG 329.29A
Total=10.1(0.99)MVA
5.2km
Kingbird
531.5A
Drowell_SS_Opt1
94.81%
øG 289.50A
0 0 0 0
Total=9.6(1.00L)MVA
Calc4
NSolarReserve_Opt1
98.00%
øG 102.04kA
Total=9.9(1.00)MVA
P=177.1A S=512.5A
NSolarReserve_TRF_Opt1
100.74%
øG 329.29A
Total=9.8(1.00)MVA
5.2km
2xKingbird
512.6A
NDrowell_SS_Opt1
98.31%
øG 308.78A
0 0 0 0
Total=9.6(1.00L)MVA
PV to Drowell SS
33kV
Hare ACSR
7.2km
Calc5
NNSolarReserve
100.00%
øG 100.00kA
Total=9.8(1.00)MVA
P=171.3A S=171.3A
NNSolarReserve_TRF
100.00%
øG 100.00kA
Total=9.8(1.00)MVA
7.2km
Hare
171.3A
NNDrowell_SS
98.08%
øG 3.08kA
0 0 0 0
Total=9.6(1.00L)MVA
Calc6
NNNSolarReserve
100.00%
øG 100.00kA
Total=9.7(1.00)MVA
P=169.6A S=169.6A
NNNSolarReserve_TRF
100.00%
øG 100.00kA
Total=9.7(1.00)MVA
7.2km
2xHare
169.6A
NNNDrowell_SS
99.05%
øG 5.99kA
0 0 0 0
Total=9.6(1.00L)MVA
PV Opt1 to Drowell SS
33kV
Hare ACSR
5.2km
Calc7
NNSolarReserve_Opt1
100.00%
øG 100.00kA
Total=9.7(1.00)MVA
P=170.4A S=170.3A
NNSolarReserve_TRF_Opt1
100.00%
øG 100.00kA
Total=9.7(1.00)MVA
5.2km
Hare
170.3A
NNDrowell_SS_Opt1
98.62%
øG 4.22kA
0 0 0 0
Total=9.6(1.00L)MVA
Calc8
NNNSolarReserve_Opt1
100.00%
øG 100.00kA
Total=9.7(1.00)MVA
P=169.2A S=169.1A
NNNSolarReserve_TRF_Opt1
100.00%
øG 100.00kA
Total=9.7(1.00)MVA
5.2km
2xHare
169.1A
NNNDrowell_SS_Opt1
99.32%
øG 8.13kA
0 0 0 0
Total=9.6(1.00L)MVA
Page 1

APPENDIX F

CORRESPONDENCE WITH GOVERNMENT DEPARTMENTS

APPENDIX F1

PROOF OF SPECIAL CONSENT APPLICATION SUBMITTED

Received: CB Stevens
5/9/17

31 August 2017

FOR ATTENTION: ISABEL OLIVIER
Town Planner: Development Facilitation/GIS
Directorate: Economic Development, Human Settlement & Planning

Our ref: T1710 -la

Hunter Theron Inc
TOWN PLANNERS

Dear Sir,

SPECIAL CONSENT: URBAN SOLAR FARM ON A PART OF THE REMAINDER OF THE FARM WHEATLANDS 260 IQ

1. Application is herewith lodged in terms of Section 35 of the Rand West City Local Municipality Spatial Planning and Land Use Management By-laws, 2017, read in conjunction with Clause 7 of the Peri-Urban Areas Town Planning Scheme, 1975:

   - To obtain Council's Special Consent to utilize Part of the Remainder of the farm Wheatlands 260 I.Q. (the site) for an Urban Solar Farm (USF).

2. We enclose hereto the following documentation for your records, perusal and distribution in support thereof:-

   - **1 Copy of:**
     - Formal Application:
     - Annexures:

ANNEXURE A	:	Locality Plan
ANNEXURE B	:	Proposed Layout Plan - USF
ANNEXURE C	:	Electrical Services Outline Scheme Report – Cintro Consulting Engineers
ANNEXURE D	:	Civil Services Outline Scheme Report Kantey & Templer Consulting Engineers Pty Ltd
ANNEXURE E	:	Special Power of Attorney & Company Resolution – Solarreserve SA Management (Pty) Ltd
ANNEXURE F	:	Title Deed T26802/1970
ANNEXURE G	:	Council Support letter dated 22 September 2016
ANNEXURE H	:	S.G. Diagrams (SG. No. A1369/1922, A7625/1994 & A3099 / 1978
ANNEXURE I	:	Draft Lease Area Diagram - subject to final Survey
ANNEXURE J	:	Electrical Route Alignment T1710 / 1 Servitude
ANNEXURE K	:	BAR – Bokamoso Environmental Consultants

53 Conrad Street
Florida North 1709

PO Box 489
FLORIDA HILLS 1716

Tel no:
(011) 472-1613
(011) 472-4559

Fax no:
(011) 472-3454

Website:
www.huntertheron.co.za

E-mail Drawings:
httrp@iafrica.com
E-mail: Administration:
htadmin@iafrica.com

Directors:
CS Theron Pr. Pln*
A/638/1991
EC Taute Pr. Pln*
A/101/2009

Associate:
N.Conradie

*Pr. Pln: Registered Professional Planner

Reg. No.:
1992/005463/21

SAACPP
SOUTH AFRICAN ASSOCIATION OF CONSULTING PROFESSIONAL PLANNERS

APPENDIX F2

RAND WEST CITY LOCAL MUNICIPALITY FEEDBACK ON PROPOSED SOLAR FARM

DEPARTMENT:
ECONOMIC DEVELOPMENT & PLANNING

RAND WEST CITY
LOCAL MUNICIPALITY

Our Ref./Ons Verw./Inamba Yethu: 16/1/1
Enquiries/Navrae/Imibuzo: I Olivier

22 September 2016

Mr. Chris Theron
Hunter Theron Inc.
P O Box 489
Florida Hills
1716

Sir

PROPOSED SOLAR FARM ON A PORTION OF THE REMAINDER OF THE FARM WHEATLANDS 260 IQ, RANDFONTEIN

Your letter dated 22 August 2016 in the above-mentioned regard refers.

The subject portion of land is, in terms of the Peri Urban Town Planning Scheme, 1975, zoned for 'Undetermined" and is in terms of the Randfontein SDF earmarked for agricultural use.

Although the proposed development and the locality thereof as depicted on the accompanied map can from a town planning view be supported in principle, the following concerns were raised by other relevant officials that cannot be overlooked:

- there is currently no electricity available for the operations of the solar farm and this scenario will remain unchanged until the new planned municipal substation is completed. Funding for such substation still need to be sourced;
- the direct environmental impact of installing a solar farm has to do with the clearing of large areas of land which in turn affects native vegetation and wildlife in numerous ways and has an adverse ecological impact and can affect the rainfall and the drainage of a region;
- Reflected light beams coming from the concentrated solar power system can, if misdirected, interfere with aircraft operating pathways;
- Concentrating Solar Power (CSP) system operations involve high temperature emissions in surroundings which may pose an environmental risk; and
- such facilities also produce electric and magnetic fields which can hamper the natural surroundings.

If all the above-mentioned negative factors can be out-ruled by the outcome of the Environmental Impact Assessment, the services analyses and all other necessary feasibility studies done by relevant specialists, as well as a thorough public participation process, the application can be submitted to the Rand West City Council for final

consideration.

Should you require any further information or clarity, please contact Vusi Hadebe/Isabel Olivier at Tel. (011) 411-0318.

Yours faithfully

J.T. MOLOI
EXECUTIVE MANAGER:
ECONOMIC DEVELOPMENT & PLANNING

APPENDIX F3

WEST RAND DISTRICT MUNICIPALITY COMMENTS ON DRAFT BASIC ASSESSMENT REPORT

WEST RAND DISTRICT MUNICIPALITY

GAUTENG
it starts here

OFFICE OF THE MUNICIPAL MANAGER

Ref: 12/2/1/3
Your ref: 002/17-18/E0062

Bokamaso Environmental
P.O.Box 11375
Maroelana
0161

Madam

Attention: Ms A Drake
Fax: 086 570 5659

LEGAL COMPETENCY: ENVIRONMENTAL MANAGEMENT: ROUTINE ENQUIRIES: COMMENTS: DRAFT BASIC ASSESSMENT REPORT FOR PROPOSED WEATLANDS URBAN SOLAR FARM AND ASSOCIATED INFRASTRUCTURE ON THE REMAINING EXTENT OF THE FARM WHEATLANDS 260 IQ: RAND WEST CITY LOCAL MUNICIPALITY

With reference to your document dated 28 June 2017 requesting comments in the above regard, the West Rand District Municipality (Environmental Management Section) wishes to comment as follows:

- The development should comply with the Bio-regional Plan for the West Rand, published in Government Gazette 390 (2 September 2015), in all cases where land is depicted as Critical Biodiversity Areas or Ecological Support Areas.
- In the event of any development on land affected by dolomites, assessments and/or investigations need to be undertaken in line with SANS 1936-1; SANS 1936-2; SANS 1936-3; SANS 1936-4; and SANS 633, by an experienced and qualified geologists who is registered by the Council for Geosciences.
- All infrastructure and construction must comply with "The Guidelines for Consultants: Appropriate Development of Infrastructure on Dolomite" from Department of Public Works (August 2004).
- The developer should comply with the National Dust Control Regulations that were promulgated on 1 November 2013 during the construction phase of the project.
- Climate change adaptation should be incorporated into the proposed development (rainwater harvesting, grey water use).
- A dolomite safety clearance certificate should be obtained from the Head of Disaster Management of the West Rand District Municipality.
- Indicate the photovoltaic degradation rates and how it will be addressed to ensure sustainability.
- Indicate if the proposed Solar PV Power Facility would affect the rainfall and the drainage of the region.