RE Capital 3 Solar Development

December

2013

Facility Layout Report pertaining to the RE Capital 3 Solar Development near Upington. Compiled by Solek (Renewable Energy Engineers).

Layout Report

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Introduction

RE Capital 3 (Pty) Ltd as an Independent Power Producer (IPP) is proposing the establishment of a commercial solar energy facility on a site in the Northern Cape. The facility is to be known as RE Capital 3 Solar Development, of size 225 MW. The project will consist of and be developed in three phases, consisting of 75 MW each.

Each phase will occupy between 165 ha and 250 ha (rough estimate). For each phase the estimated portion of land that each component of the facility will typically occupy is summarised in the table below. The average size of each phase was taken as 200 ha:

Table : Component size and percentage for each phase

Component	Estimated extent of each 75 MW plant	Percentage of selected area (± 200 ha)	Percentage of whole farm (±5725 ha)
PV modules	180 ha (1.8 km^2)	90%	3%
Internal roads	18 ha (0.18 km^2)	9%	0.3%
Auxiliary buildings	2 ha (0.02 km^2)	1%	less than 0.1%

Table : Component size and percentage for total plant

Component	Estimated extent of the total plant	Percentage of selected area (± 600 ha)	Percentage of whole farm (±5725 ha)
PV modules	540 ha (5.4 km^2)	90%	less than 10%
Internal roads	54 ha (0.54 km^2)	9%	less than 0.9%
Auxiliary buildings	6 ha (0.06 km^2)	1%	less than 0.1%

The proposed infrastructure that is planned to be constructed includes CPV modules, or a series of solar PV arrays, inverters, internal electrical reticulation, and an internal road network. It will also be necessary to construct an onsite substation which would typically include a transformer to allow the generated power to be connected to Eskom's electricity grid. Auxiliary buildings, including ablution, workshops and storage areas, are planned to be erected. A distribution line will also be required to distribute the generated electricity from the site to the Eskom substation and grid.

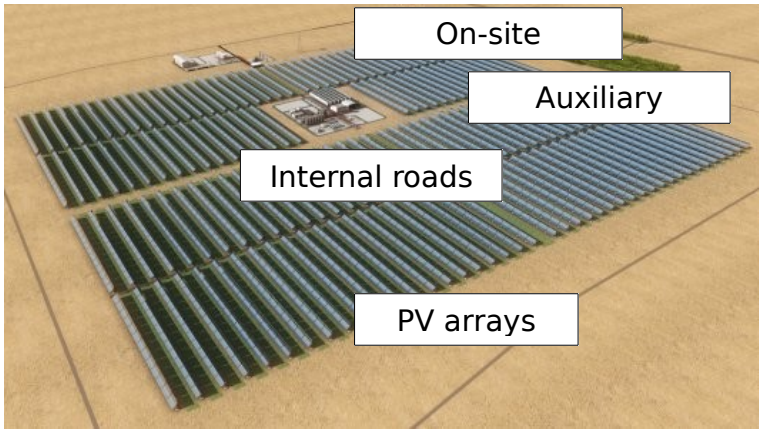

Figure : A typical layout of a solar PV plant

Determining the optimal layout is a costly process which would normally take place once an IPP tender has been awarded to the bidder. For the purpose of the environmental impact assessment, a typical layout will be discussed, alternatives will be investigated and a preliminary high level layout will be drafted. The final layout design that will be done after bidding will take into account the site constraints identified and recommendations made by the various EIA specialists. With the actual construction, the final plant layout will stay the same in terms of footprint and size, but the exact location of the different components may change within the 750 ha boundary.

Layout Progression

In the Scoping Phase of this project two alternative locations for the proposed facility were investigated. The one option was referred to as the Northern site and the other the Central Site. Since the location of the Central site is closer to the proposed Eskom MTS Substation, and possible future expansions, it was decided to only continue with the Central Site for the Re Capital 3 project. The Central site will be discussed in more detail below.

(Please note that all images refer to North as the top of the page unless otherwise specified.)

Scoping Phase Initial Layout

Initially, a 500 ha area was identified and studied during the scoping phase of the Re Capital 3 project. The 500 ha area was identified because of its level surface, fairly easy access, and the close proximity to the proposed new MTS substation. The low concentration of nutrients in the soil also means that vegetation is not very dense or high, eliminating the chances of casting shadows on the solar arrays or having an effect on food security.

The identified 500 ha study area was divided into three parts of approximately 165 ha each for the three phases of the development. An illustration was given of how a typical layout on each of the phases will look like (see figure below). Each phase will consist of the same list of components. As explained in more detail in the Engineering Report (Solek, December 2013), these components

include solar modules, roads, workshop and admin office area, laydown area, and an onsite substation.

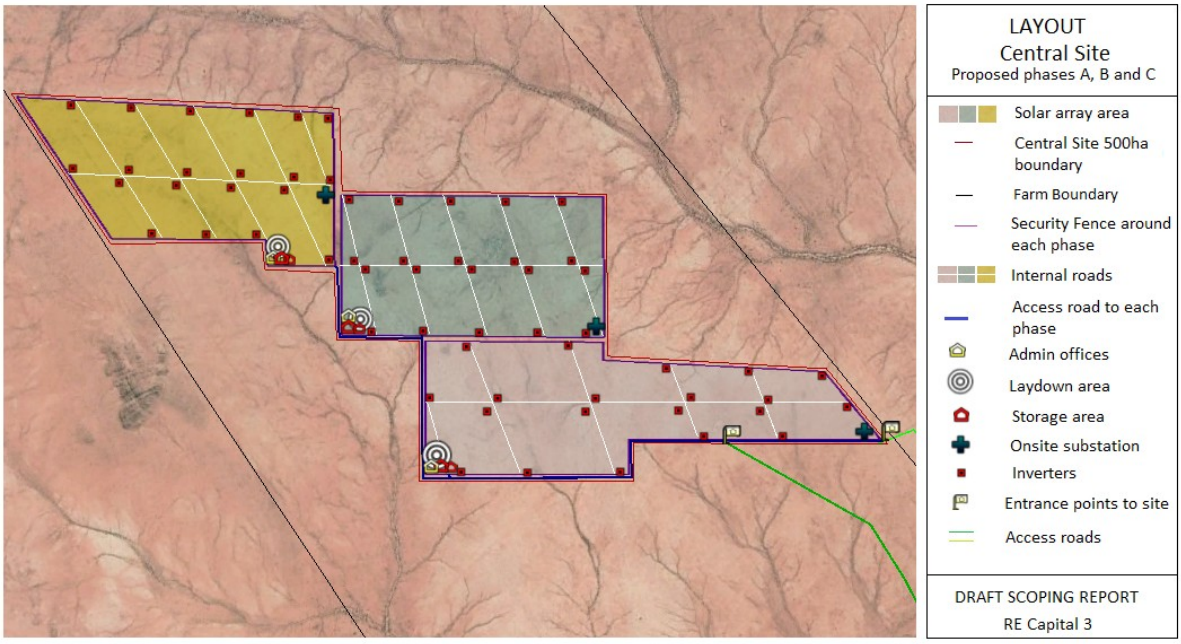

Figure : Initial Scoping Phase Layout, preliminary phase A, B and C

Adjustment to the Scoping Phase

Study Area Expansion

After the scoping phase, it was decided to increase the 500 ha study area to 750 ha in order to have enough space to be able to avoid the most environmental sensitive areas. The expanded area with the original 3 phases are shown in the figure below:

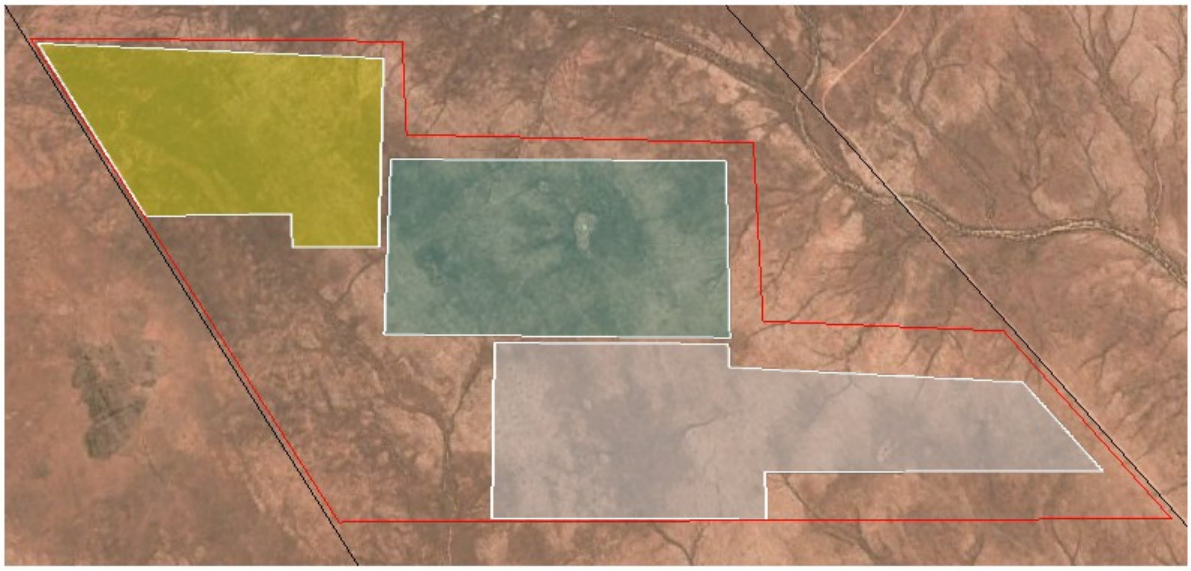

Figure : Expanded central site area (750 ha)

In the scoping phase of the project each phase in the initial layout occupied approximately 165 ha. This area has been increased to 200 ha. For the impact assessment phase of the project, combinations of layouts of the three phases will be investigated.

Additional Access Routes Included

In the scoping phase of the project two access road alternatives were investigated. These two routes have been expanded into five alternatives that will be investigated further in this report.

Additional Power Line Routes Included

In the scoping phase of the project four power line alternatives were investigated. After various discussions with the neighbouring farmers it was decided to include two more alternatives. All six alternatives will be discussed further in this report.

Layout Alternatives

During the planning phase of the project numerous layouts and technologies were taken into consideration before the preferred proposal was decided upon. The two major points which lead to the preferred/mitigated proposal were the following:

- Three uniform areas between 200 ha and 250 ha each, to ensure the project would be economically viable;
- Minimal disturbance to water washes and highly sensitive areas.

The factor having the single biggest influence on the second point is the mounting technology. The preferred technology should allow arrays to be constructed over the wash lines and high sensitivity areas while having a minimal effect on the vegetation, mitigating the chances of erosion.

Original 750ha Layout

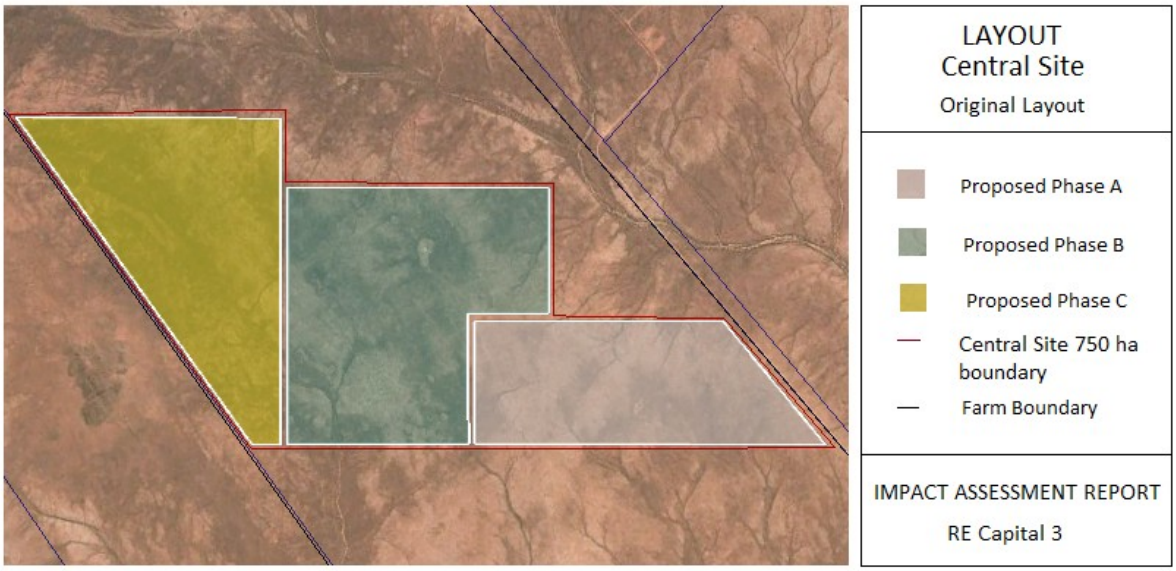

Figure : Original 750ha layout, phases A, B and C (Sensitive areas not included)

After the study area was increased to 750ha, the 750ha was divided in three phases, approximately 250 ha each. If there were no environmental sensitive areas, this would have been the ideal layout for the three phases of the project. This layout is further referred to as the Original 750ha layout.

Sensitive Areas identified by specialists

Feedback was given by the ecological specialists, and the sensitive areas were mapped on the layout.

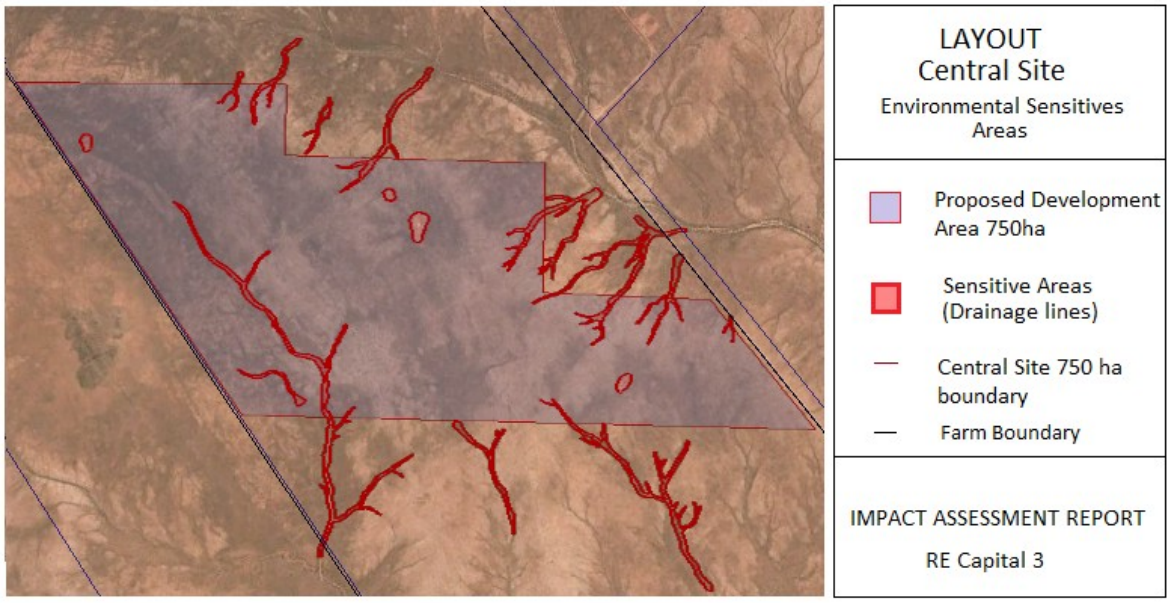

Figure : Sensitive Areas on and around the 750ha study area

The ecological study showed there are some drainage lines on the proposed development area that need to be taken into account. There is one larger drainage line to the left bottom corner of the site that, according to the

ecological specialist, is the major part that needs to be avoided. The smaller drainage lines should be avoided as far as possible, but if this is not completely possible, it should not have such a big impact. Because of the foundation of the modules, the mounting methods used and the space in between the modules, it will be possible to construct the solar modules over the end parts of the smaller drainage lines without having a significant negative effect on the drainage line. The ecological specialist will be able to comment on this.

There are also four pans on the proposed development area. The ecological study indicated two of these as sensitive. The map below shows the major drainage line and two pans that have been indicated as more sensitive.

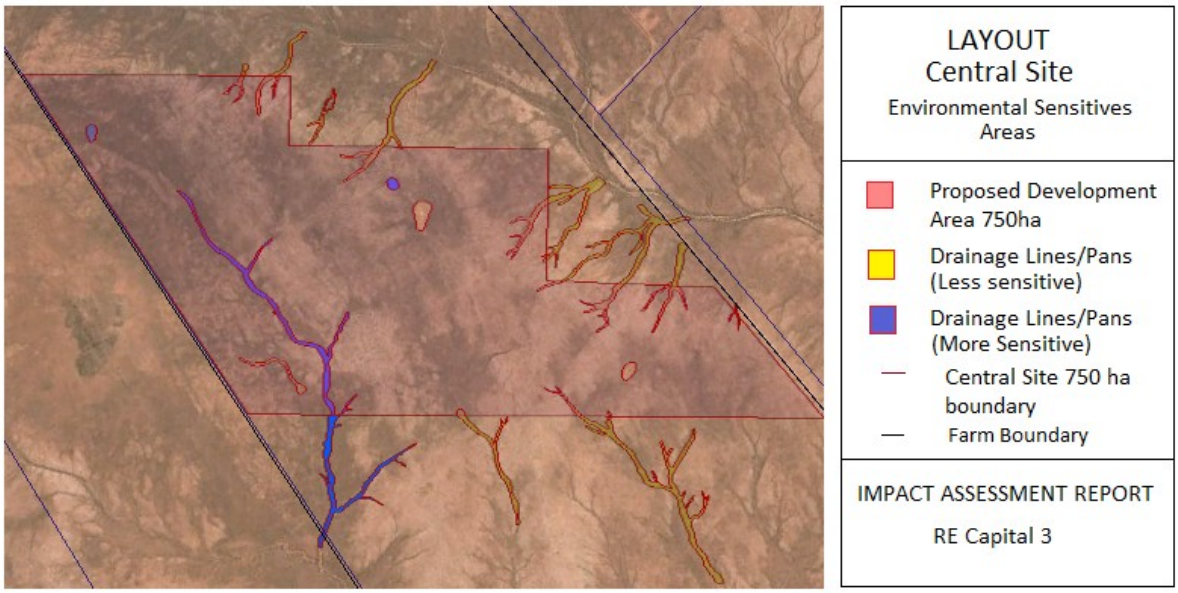

Figure : Higher and Lesser Sensitive Areas

Layouts Incorporating Sensitive Areas

Uniform Layout

As a first layout option, the sensitive areas were added to the original 750ha layout. This is referred to as the Uniform Layout. In the Uniform layout it is proposed to build across the drainage lines in order to keep the solar design as rectangular as possible. The solar frames can be installed using a ramming method which would have the minimum impact on the environment. As far as practically possible the ramming poles would be driven as far as possible from all drainage lines and sensitive areas to take the ecological constraints into account.

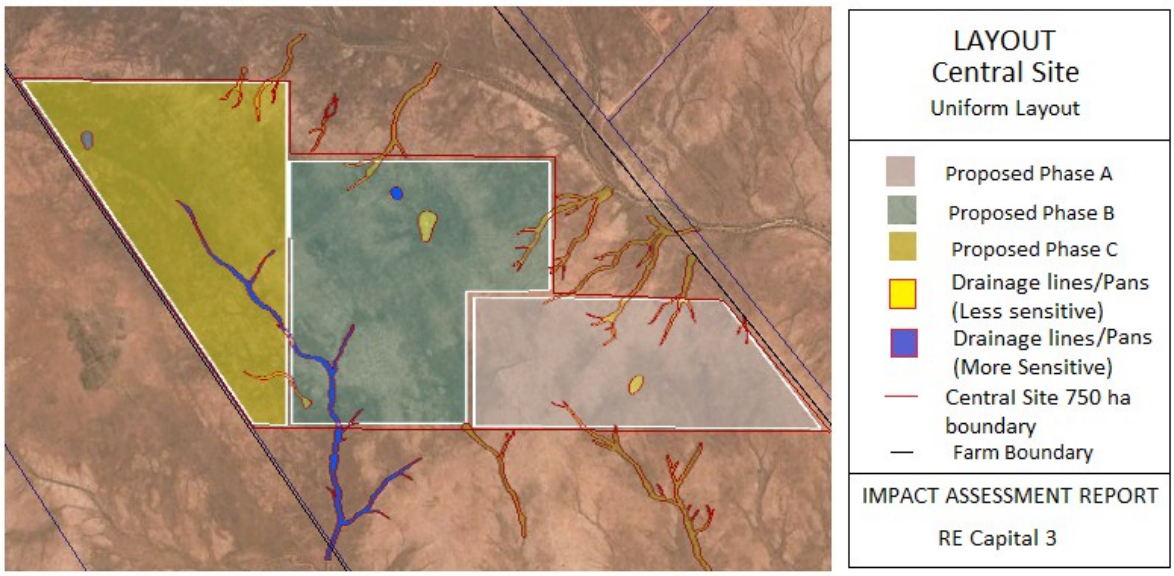

Figure : Uniform layout (750ha including sensitive areas)

Alternative Layout (Preferred Layout)

In order to avoid the major drainage line in the bottom left of the study area and the two sensitive pans, as well as the smaller drainage lines as far as possible, an alternative layout was constructed. The borders of the 3 phases were adjusted in order to keep the developable area for each phase more or less the same size. The “Alternative Layout” as illustrated in the figure below is seen as the preferred alternative.

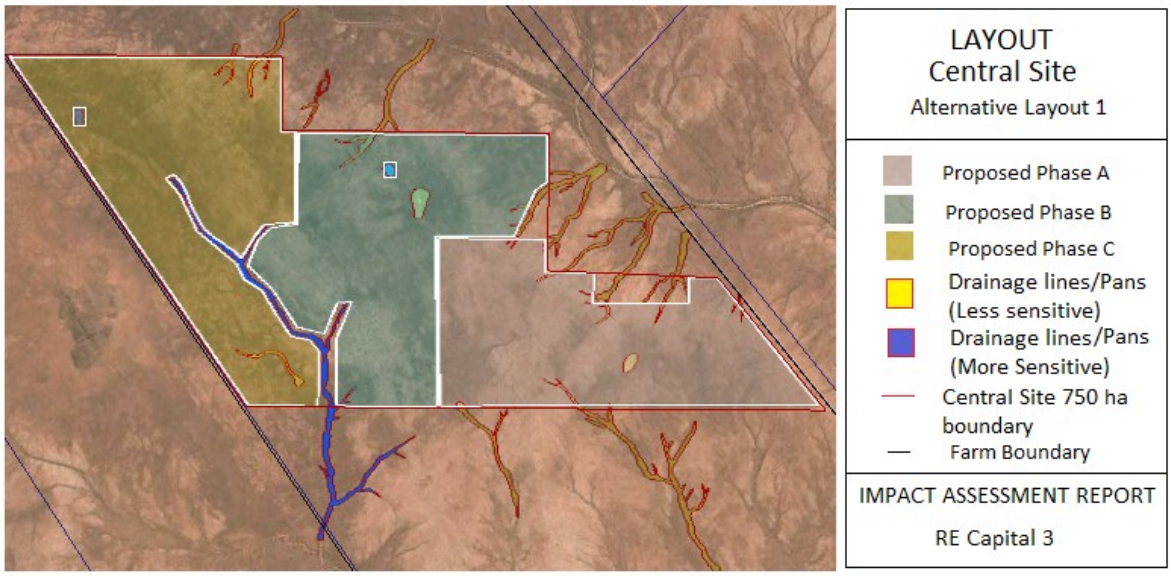

Figure : Alternative (Preferred) layout (Development area avoiding high sensitive areas)

As mentioned before, the solar arrays will be placed in such a way that would have the least influence on the drainage lines while avoiding the ecological sensitive areas where practically possible. Although the annual rainfall within this region is extremely low, the drainage lines were carefully considered and the most viable alternative selected.

Because of the relatively dry climate and low rainfall, natural vegetation tends to be denser within the drainage washes, thus the layout which has the smallest impact on the washes would generally also have the smallest impact on the vegetation.

Layout Component Explanation

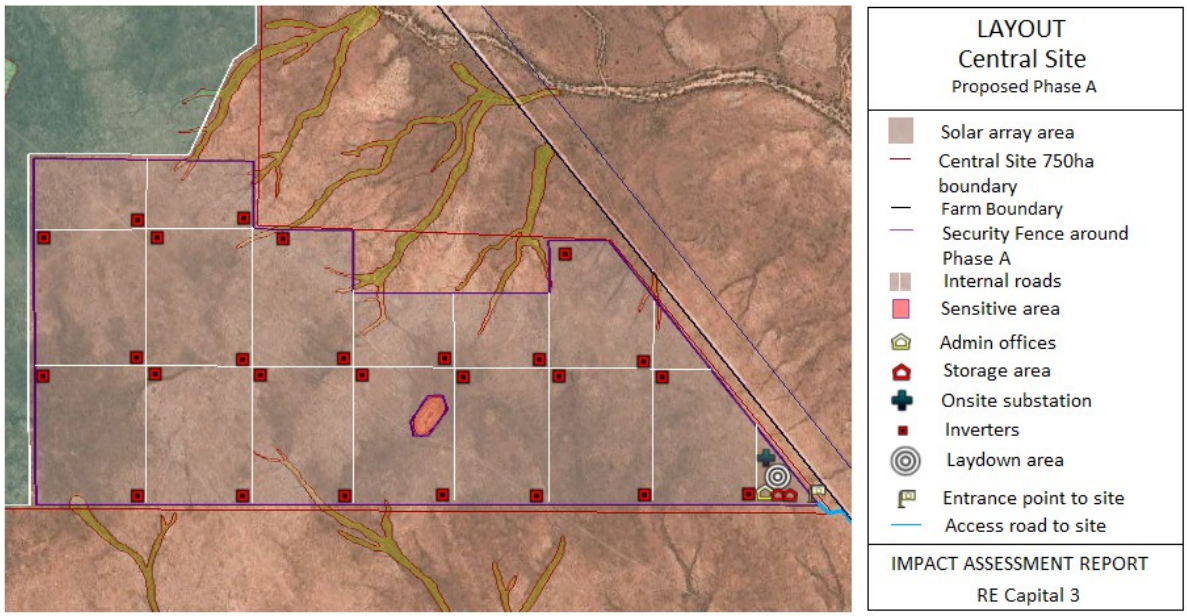

Figure : Site Layout (Phase A)

Above is an illustration of how a typical layout on each phase will look like. Each phase will consist of the same list of components. As explained in more detail in the Engineering Report (Solek, December 2013), these components include solar modules, roads, workshop and admin office area, laydown area and an onsite substation. The exact position of these components will be determined with the final plant design after bidding.

The infrastructure of each phase will have a footprint of approximately 200 ha and is aimed at having the lowest possible environmental impact while keeping the project economical viable.

General Explanation of the Layout:

A general explanation of the components of the layout will be discussed below. This general explanation will be applicable on all the preliminary layouts that will follow later in the document.

Solar Panel Area

The solar arrays are put together with strings of solar modules connected in series, which can be mounted onto single or double axis tracking systems. These frames are typically installed with the single tracking axis in an east-west direction to maximise the system's output. The standardised length of a solar array would typically be between 50 and 200 m long. Where a tracker system is used, each of the modules is controlled individually and standardised systems are preferred for economic and practical reasons.

The solar modules will be placed in such a way that it would have the least influence on the washes and avoiding the ecological boundaries set where practically possible.

Mounting of the Modules

As discussed in the Engineering Report, the foundation of mountings can either be laid in a small concrete block, driven piers, or a deep seated screw mounting system. The impact on agricultural resources and production of these alternatives are considered equal, although the concrete option will require greater inputs during decommissioning in order to remove the concrete from the soil. As far as practically feasible the poles would be driven in as far as possible from all washes, and taking the ecological constraints into account.

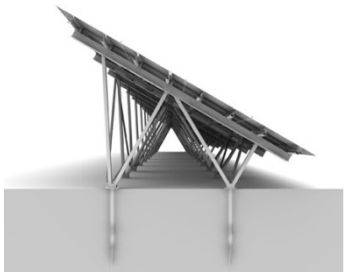

Figure : Rammed or screwed mounting method on fixed frame (image www.expo21xx.com)

The physical process of ramming the anchors into the ground is done using yellow equipment (typically on tracks). In the case where earth screws or rock anchors would be more suitable, the rammed pole would be replaced by one of the former. The figure below shows equipment being used in the ramming process. Some of the ground covering in the medium sensitivity area will be cleared to do the frame installation accurately. Although the site is very flat, some minor excavation may be necessary in certain medium sensitivity areas.

In the areas of high sensitivity, vegetation would be left in place to avoid the risk of erosion. In the unlikely case where brush or trees are high enough to cast shadows they would be trimmed to size.

Figure : (Image from www.aceinfra.com and www.kaska.eu)

Grid Connection and Cabling

The electrical feeding line (or two lines, depending on the line capacity) is proposed to be constructed to connect to the new planned Eskom MTS Substation. Depending on the location of the new MTS, the power line/s

alternative is investigated for different routes. This electrical line/s would run along the border fence or the existing 132 kV power line to minimise the effect on the environment. This electrical line/s would be kept above ground and would feed into the new MTS with a 132 kV line.

A 75 MW installation would most probably make use of 75 inverting stations for converting the power produced to such a form that it could be fed into the electricity grid. These inverting stations are connected to a series of arrays and would be placed along the service roads to give quick and easy access. The inverters indicated in the figures give a rough illustration of how the inverters will typically be distributed across the array area, but the illustration does not give an exact representation of the amount of inverters or their positions. The final placement of the inverting stations would take the ground conditions into consideration, meaning that suitable areas with a minimal impact on the environment would be preferred. Interconnecting cables may be trenched where practically possible. However, in areas of high sensitivity cables would be mounted to the structure to avoid excessive excavation works and clearing of vegetation. These inverter stations would typically be built into a transportable container measuring 10 x 2.5 m, having a footprint of 25 square meters.

Auxiliary Building Area

The main storage, workshop, ablution, and administration facilities are placed in an area where there will be easy access. The preferred location would be to the south of the development area to avoid shadows being cast onto the solar arrays. The final storage and administration areas would also be selected to minimise their impact on the environment by considering the ground conditions and the ecology of the surrounding areas. Since this area may host more human activity than most other parts of the solar facility, it is important to take the surrounding habitat into consideration. The structure erected should not be more than 2000 square meters in area and is referred to in the preceding drawings as the Storage and Admin facility. Water to the facilities will be supplied by ten 1 kl water tanks. These tanks will also be used as redundant water for operation of the plant.

Construction of Roads

In the case where access roads cross the washes or where they are in the close vicinity of the washes special care and precautionary measures must be taken to mitigate the risk of erosion due to ground disturbances. By incorporating precast concrete infrastructure into the construction of these roads the risk of the roads acting as water channels could be avoided. Special attention to drainage, water flow and erosion will be given and potential risks will be mitigated by applying appropriate building methods.

Proposed Layout for Phases A, B and C

The general explanation of the layouts in the previous section gives a bit more detail regarding the components indicated in the figures in this section.

Below are the three proposed layouts for phases A, B and C. The layouts for Phases B and C look more or less the same as Phase A.

The area indicated in Phase A as the “sensitive area” will be handled as a sensitive area during construction, and as far as possible, the poles will be constructed around this area in order to avoid as much as possible disturbance. Please note, the auxiliary buildings (admin office, storage area, laydown area) and substation is indicated in the right corner, but the exact location can still change.

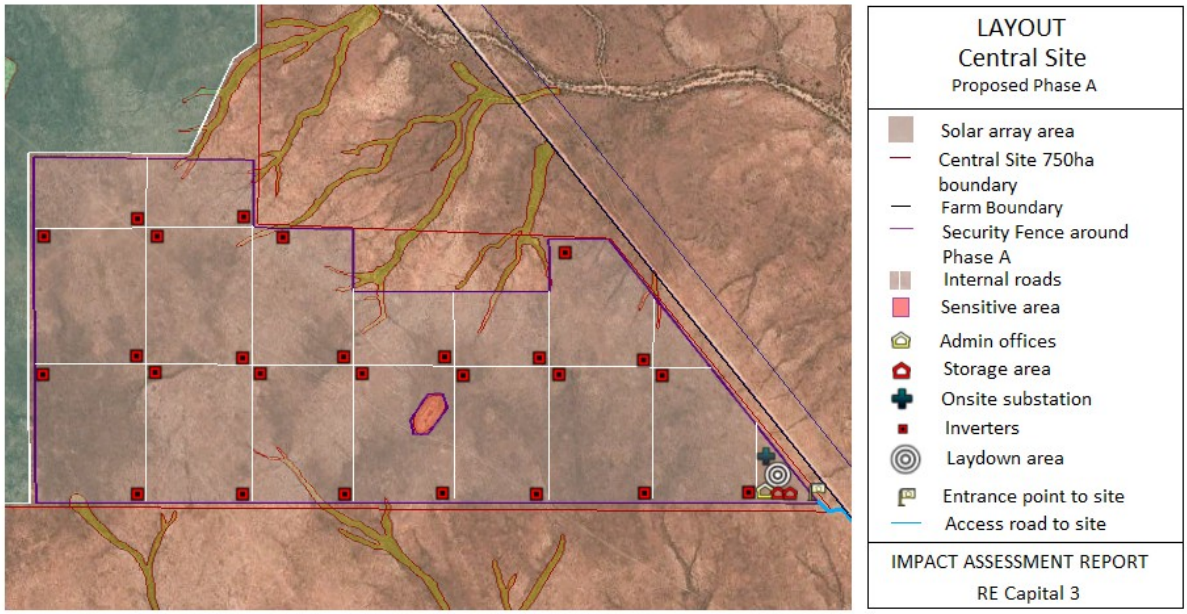

Figure : Proposed Layout Phase A

Phase B will consist of the same components as Phase A. The access road will be lengthen across the southern border of Phase A, to the entrance of Phase B. Again, the exact location of the auxiliary buildings can still change, depending on the final design after bidding, but the impact will be more or less the same.

The red area indicated on the illustration of Phase B as “No-Go sensitive area” is a sensitive pan that will have to be avoided. The area indicated as the “Sensitive Area” will again be treated with caution during construction, and as far as possible the poles will be constructed in the lesser sensitive areas.

Two substation locations have also been indicated, because of the multiple power line alternatives.

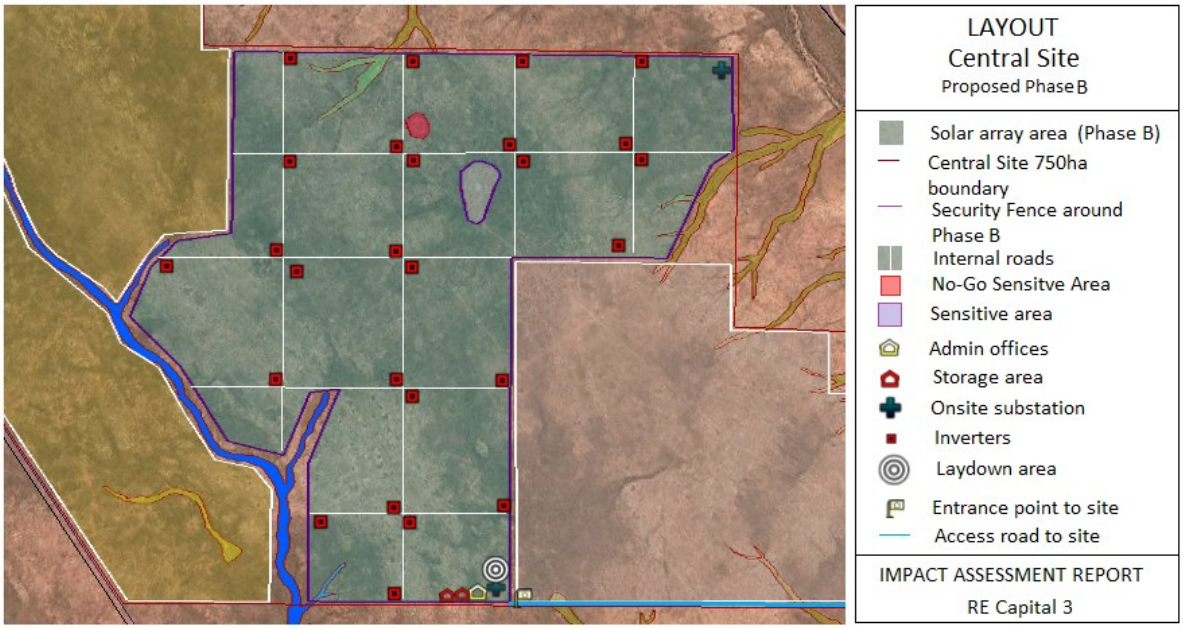

Figure : Proposed Layout Phase B

Phase C will also have the same components as ~~p~~Phases A and B. The major drainage line indicated in blue is to be avoided, as well as the "No-Go Sensitive Pan" indicated in red. The access road to ~~p~~Phase C will either be to the south of the site, in which case special measures will be put in place to cross the drainage line, or via an access road to the north of the site.

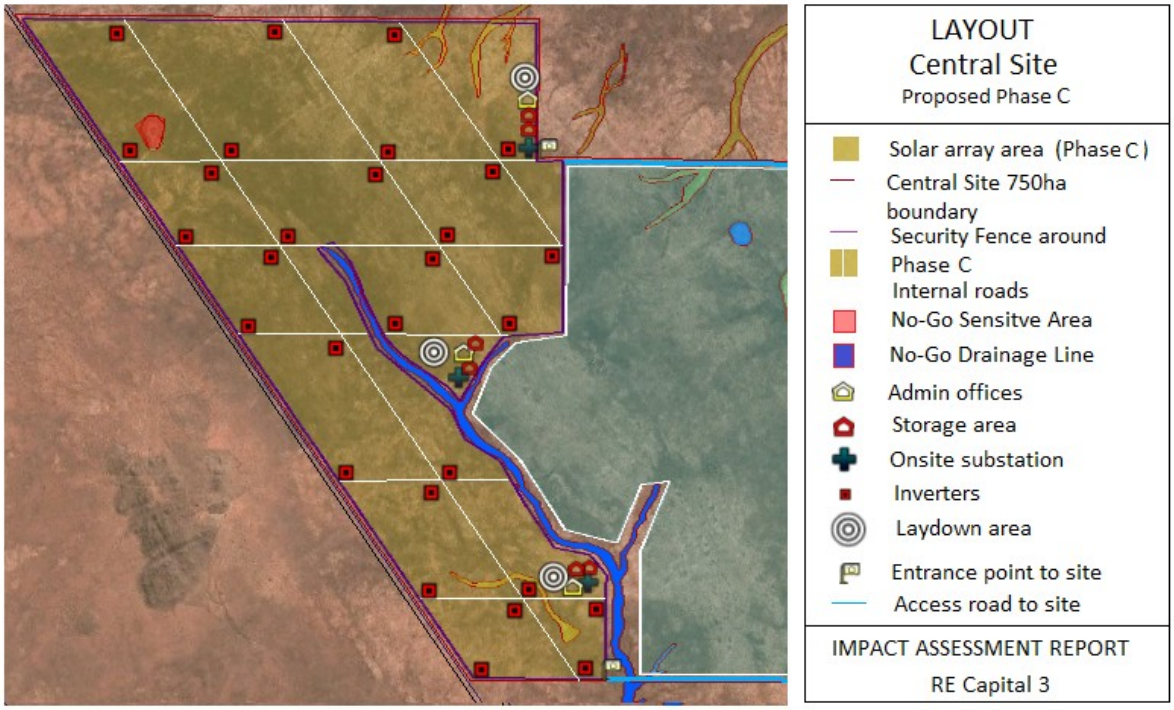

Figure : Proposed Layout Phase C

The timelines for building each phase are pending the REIPPP bidding results. The phases can either go into the same bidding round or in separate bidding

rounds. Depending on the outcome of the bidding rounds, the construction will begin a few months after the phase has been approved. The figure below gives an illustration of how the total plant will look (Phases A, B and C).

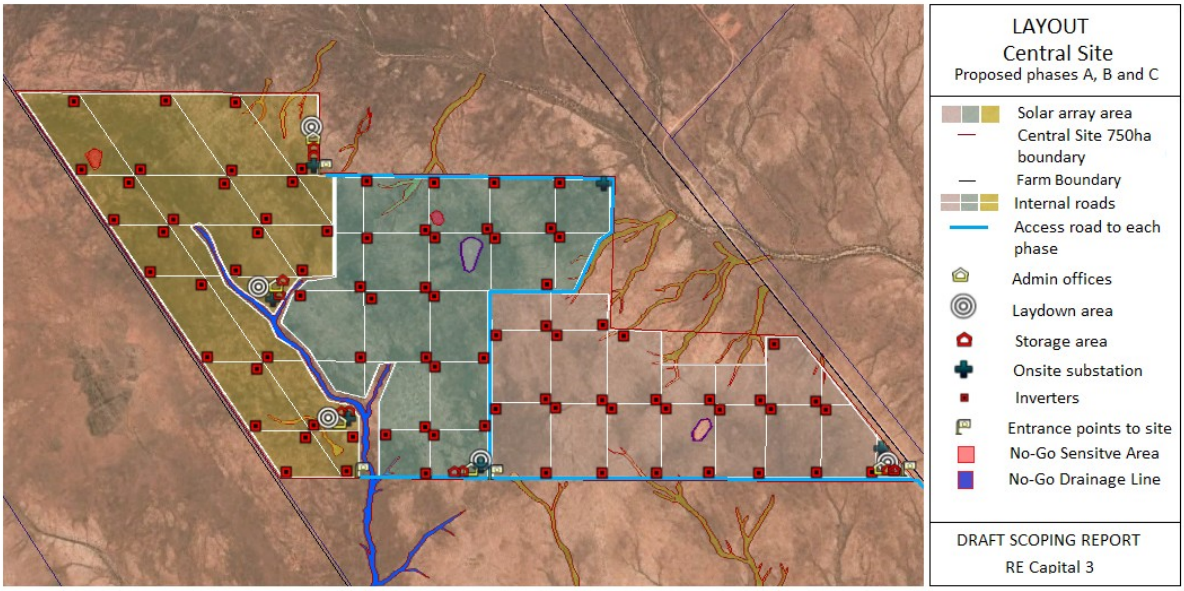

Figure : Proposed Layout for Phases A, B and C

Again, the figure gives a typical illustration of the different components that will be present on the site, but the exact location of the substation, workshop and laydown area, internal roads etc. will still vary.

Power line alternative routes

In the Scoping Phase four power line route alternatives were investigated, with the loop-in route option. Because of possible complications with neighbouring projects, it was decided to include two more alternatives to the south of the project.

The option to loop into the existing 132 kV line is investigated as one of the primary connection alternatives. This option is indicated as “Power line option 0: Loop-in” in the figure below. The other alternative routes will all lead from the individual on-site substations to one of the proposed locations for the new Eskom MTS substation. Options 1 to 4, as shown in the figure below, are all across the Tungsten Lodge property, whereas Options 5 and 6 are across the McTaggarts Camp property. Option 1 will be across the neighbouring farm (Tungsten Lodge) on the southern border of the farm to one of the two possible MTS locations. Options 2 and 3 will also be across the neighbouring farm(Tungsten Lodge), running parallel and on both sides of the existing 132 kV line. Option 4 is across the n eighbouring farm(Tungsten Lodge), along the northern border of the farm, to one of the substations. Option 5 will run parallel to Option 1, but on the McTaggarts Camp side of the fence, making a loop in order to avoid the Tungsten Lodge property before it reaches the MTS substation. Finally, Option 6 is to the

south of the McTaggarts Camp property, along the N14, and then goes up to the MTS substation.

The loop-in option will be most cost effective, but this is dependent on the capacity on the line. Options 2 and 3 are the next two preferred options, being the shortest distance to the substation and parallel to the existing 132 kV line. However, the feasibility of most of these options will depend on the neighbouring project's servitude consent. That is also the reason for the large number of Options. Negotiations are in progress for all the servitudes.

The routes were all chosen along existing fences or power lines, in order to minimise the additional environmental impact. The environmental impact of these Options should all be more or less the same. There is a chance that the negotiations in terms of the servitudes across the neighbouring farms will only be finalised once the project reached preferred bidder status. It is therefore requested that all the alternatives are authorised.

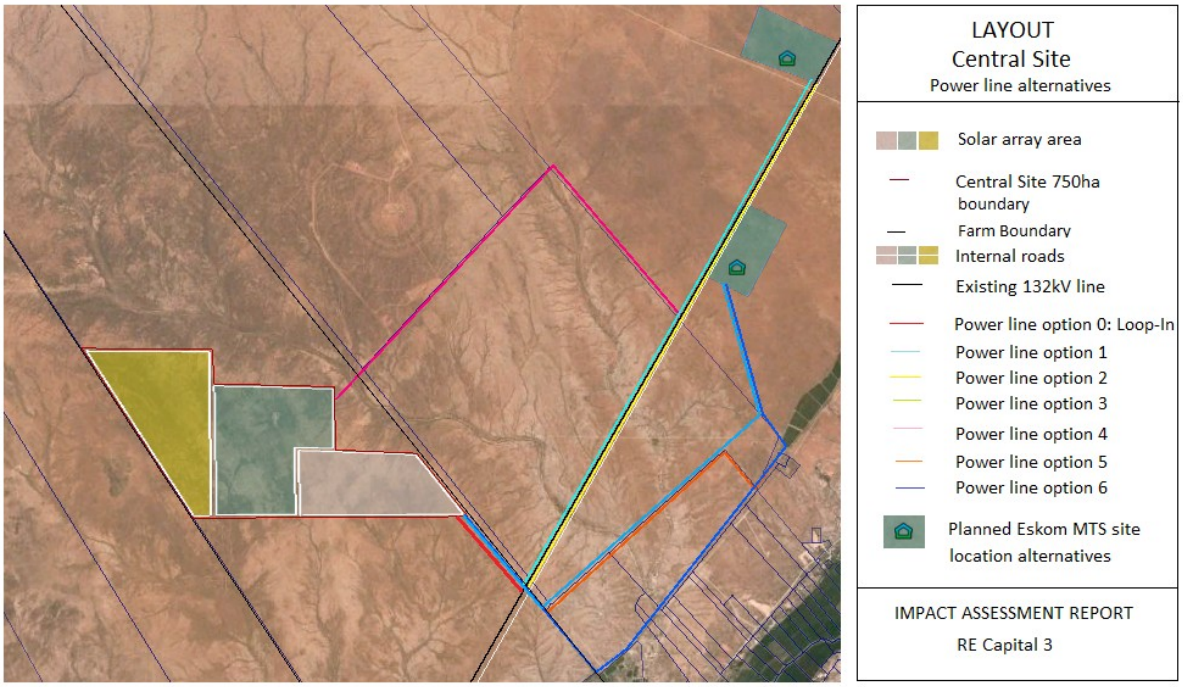

Figure : Six Power Line Alternatives for the Proposed Site

Access to the Site

In the Scoping phase of the project two access roads to the construction site were investigated. One of the roads was an existing farm road running from the N14 to the proposed site, while the other was the neighbouring project's access road. At the moment the financers of the REIPPP projects, however, insists that the projects are ring-fenced, so the neighbouring project's access road is no longer an option. The RE Capital 3 project will need to build an independent new road parallel to the neighbouring project's road, on the Dyason's Klip side of the fence.

The figure below shows the access routes that were investigated. Option 1 is an existing farm road, making use of the existing Dyason's Klip entrance from the N14. Option 2 is an existing farm road on the neighbouring farm, entering through the McTaggarts Camp entrance from the N14. There is, however, a chance this option may fall away, seeing that the farmer is planning a new development along this road. Option 3 is along the Dyason's Klip fence, making use of a new entrance from the N14 that will have to be constructed. Option 4 runs parallel to Option 3, but makes use of the neighbour's N14 entrance (on the McTaggarts Camp property). Option 5 makes use of the Dyason's Klip farm entrance, and then runs along the southern border of the farm to the eastern border, and then parallel to Options 3 and 4 to the proposed site.

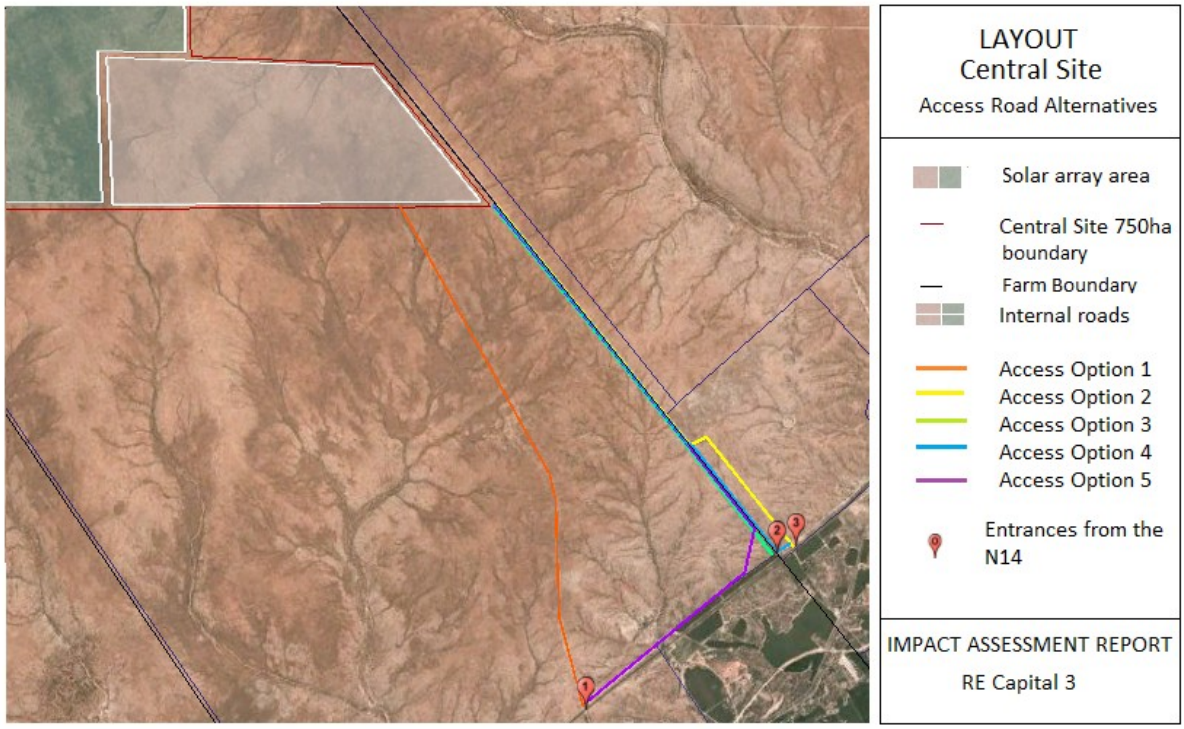

Figure : Access Alternatives to the Proposed Site

Other Projects in the Area

When considering South Africa's irradiation distribution, the Northern Cape Province, and Upington in particular, is known to be one of the most preferred areas for the generation of solar energy in South Africa and even in the world. This can be ascribed to the advantageous sun radiation specifications and the flat planes which are not intensively used except for grazing. The global irradiation in the specific area is between 2400 and 2600 kWh/m^2.

The DEA is in the process of identifying Renewable Energy Development zones (REDz) across South Africa, which are typically best suited for renewable energy generation. Upington and its surrounding area is one of the areas identified to be a Renewable Energy Development Zone.

Other solar projects that are already being developed or proposed in close vicinity to the Dyason's Klip project are provided on the map below. Some of these projects have already been awarded preferred bidder status in the previous REIPPP rounds, while others are still in the planning phase.

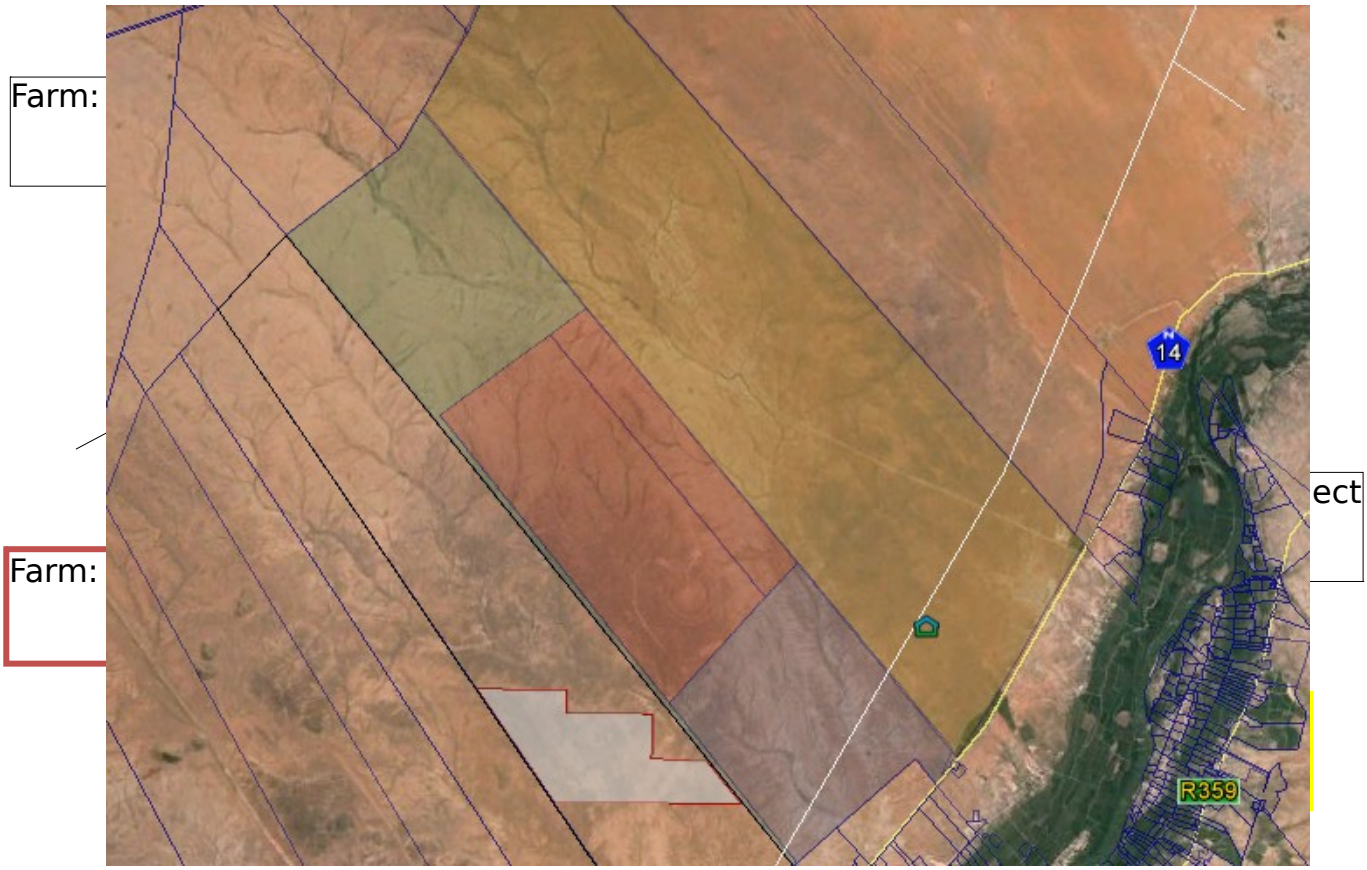

Figure : Other Projects in the Area

End Comment

The feedback from the ecological specialist showed there are not a lot of highly sensitive areas on the proposed development site. The "Alternative Layout" that was discussed takes the highly sensitive areas into consideration, avoiding the major drainage line and two sensitive pans. It is proposed that this alternative layout is seen as the preferred layout.

The multiple power line alternatives and access route alternatives are all proposed to be constructed along existing fences, routes or power lines. It is suggested that they should all have more or less the same environmental impact. The ecologist can comment further on this. Because of the fact that all the power line and access route alternatives are depended on third party approvals, it is requested that all of them are authorised from an environmental side.