RE Capital 3 Solar Development

July

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 within the Northern Cape to be known as RE Capital 3 Solar Development, of size 225MW. The project will consist of and be developed in three phases, consisting of 75MW each.

Each phase will occupy approximately 165ha (roughly estimated). For each phase, the estimated portion of land each component of the facility will typically occupy is summarised in the table below:

Table 1: Component size and percentage for each phase

Component	Estimate extent of each 75MW plant	Percentage of selected area (± 165ha)	Percentage of whole farm (±5725ha)
PV Arrays	150 ha (1.5 km^2)	91%	less than 3%
Internal Roads	12 ha (0.12 km^2)	7%	less than 0.3%
Auxiliary Buildings	1 ha (0.01 km^2)	0.6%	less than 0.1%

Table 2: Component size and percentage for total plant

Component	Estimated extent of the total plant	Percentage of selected area (± 500ha)	Percentage of whole farm (±5725 ha)
PV arrays	450ha (4.5 km^2)	91%	less than 8%
Internal roads	36ha (0.36 km^2)	7%	less than 0.7%
Auxiliary buildings	3ha (0.03 km^2)	0.6%	less than 0.1%

(Engineering Report, Solek)

The proposed infrastructure that are planned to be constructed includes a series of Solar PV arrays and inverters, internal electrical reticulation and an internal road network. It will also be necessary to construct an onsite substation which will 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 and a distribution line will also be required to distribute the generated electricity from the site to the Eskom substation and grid.

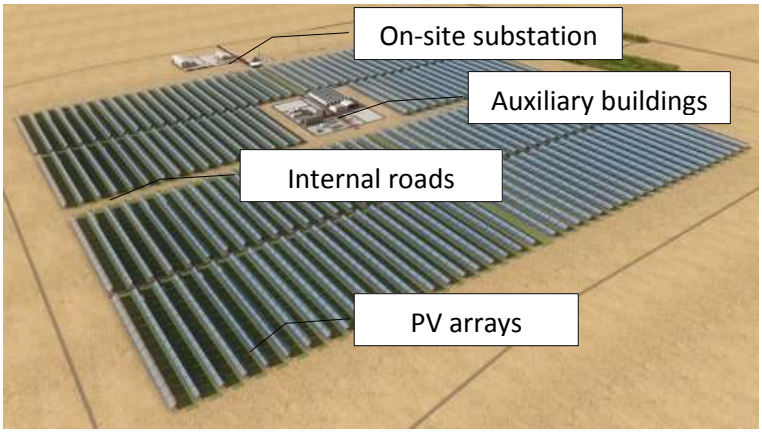

Figure 1: A typical layout of a solar PV plant

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 for each of the two sites. The final layout design that will be done after bidding, will take in 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 500ha boundary.

Alternative locations:

The Figure below shows the aerial view of the proposed 225MW Solar Facility. Two alternative locations for the proposed facility will be investigated. The one option will be referred to as the Northern site and the Central Site. Factors that will influence the final decision of whether the northern or central site will be developed include the environmental impacts, access to the site, the connection to the grid, the confirmed location of the new Major Transmission Sub-Station (MTS), water availability and the costs involved with each option.

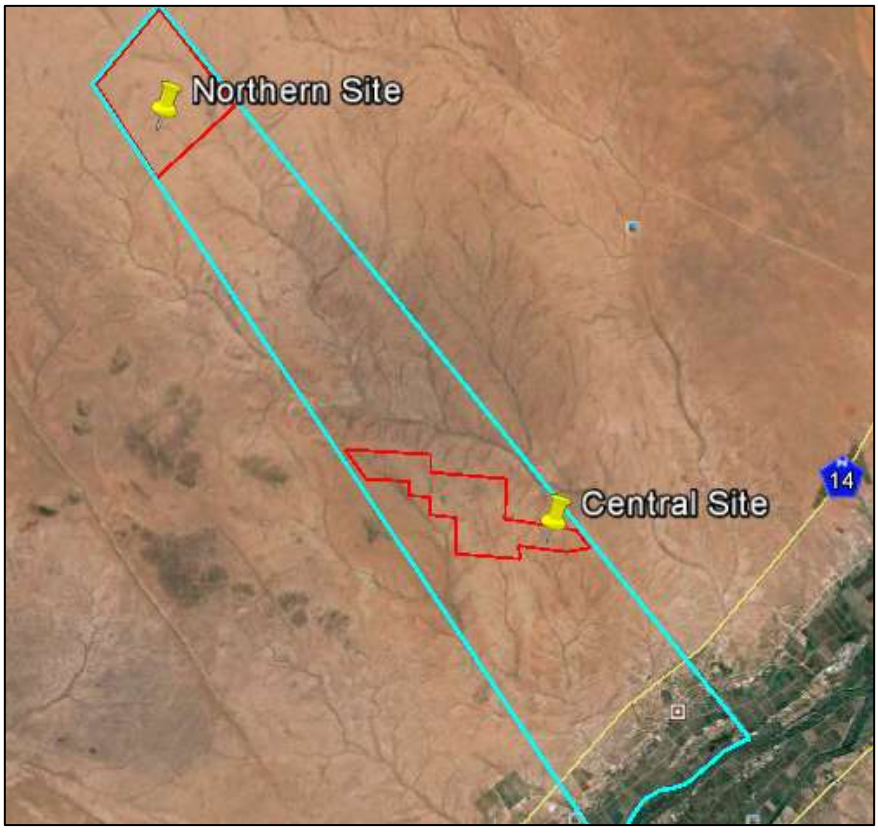

Figure 2: Areal view of proposed site for PV facility and surroundings

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

Both the Northern and Central sites will be discussed in more detail below, taking into account the access to the site, the connection to the substation and the layout of the components inside the 500ha boundary.

Northern Site

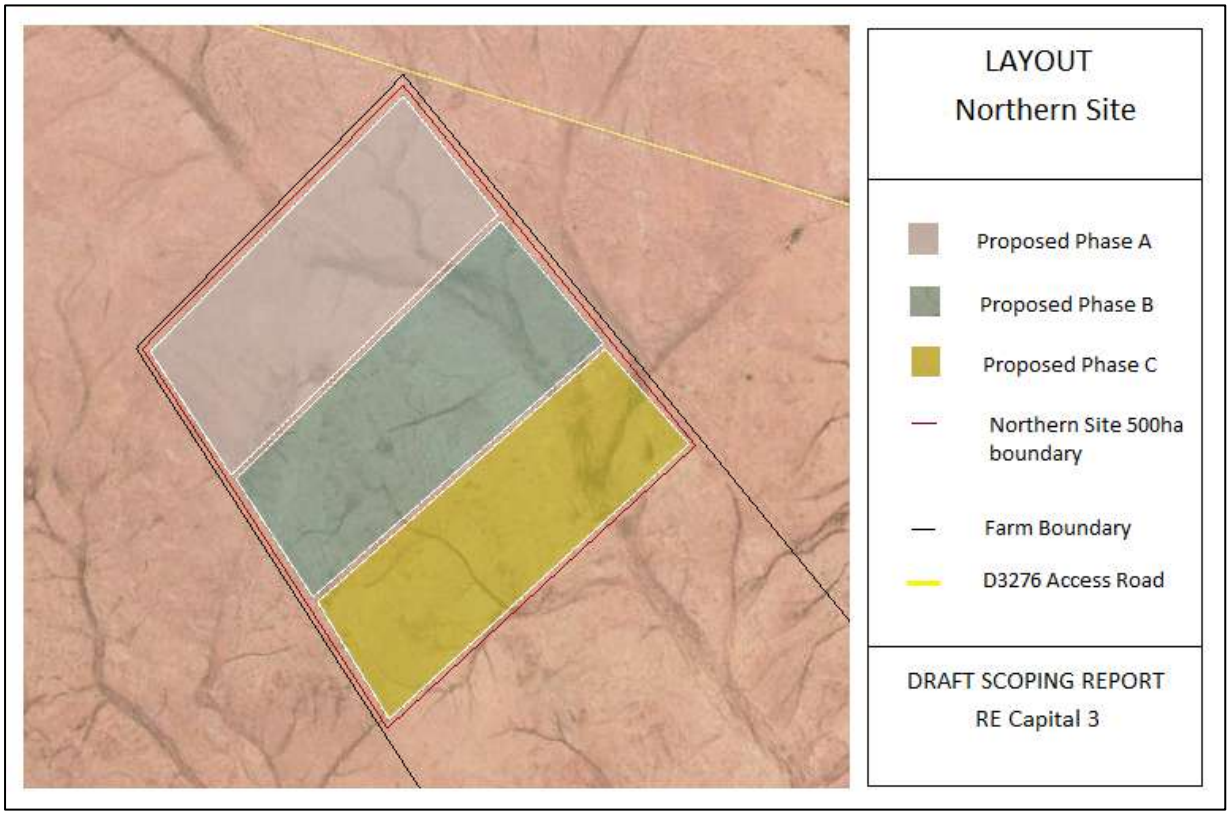

Figure 3: Northern site phase layout

The 500 hectare area was identified due to its level surface, 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 of food security.

The identified 500 hectare study area has been divided into three parts, approximately 165ha each, on which the three phases will be developed. The optimum arrangement of the three phases has not been fixed, and will only be determined once the project has been awarded preferred bidder status. The arrangement above will be used as a typical layout. In terms of environmental impact, the typical layout should give an adequate indication of the different components that will be present on site.

Access to the site

The D3276 district road runs directly past the top end of the proposed site. No additional access road will therefore be constructed. The entrance to the proposed site will be directly from the D3276. The laydown and auxiliary building area will be situated near the entrance of each phase to simplify the logistical arrangements.

Figure 4: Access to the northern site

Preliminary Layout

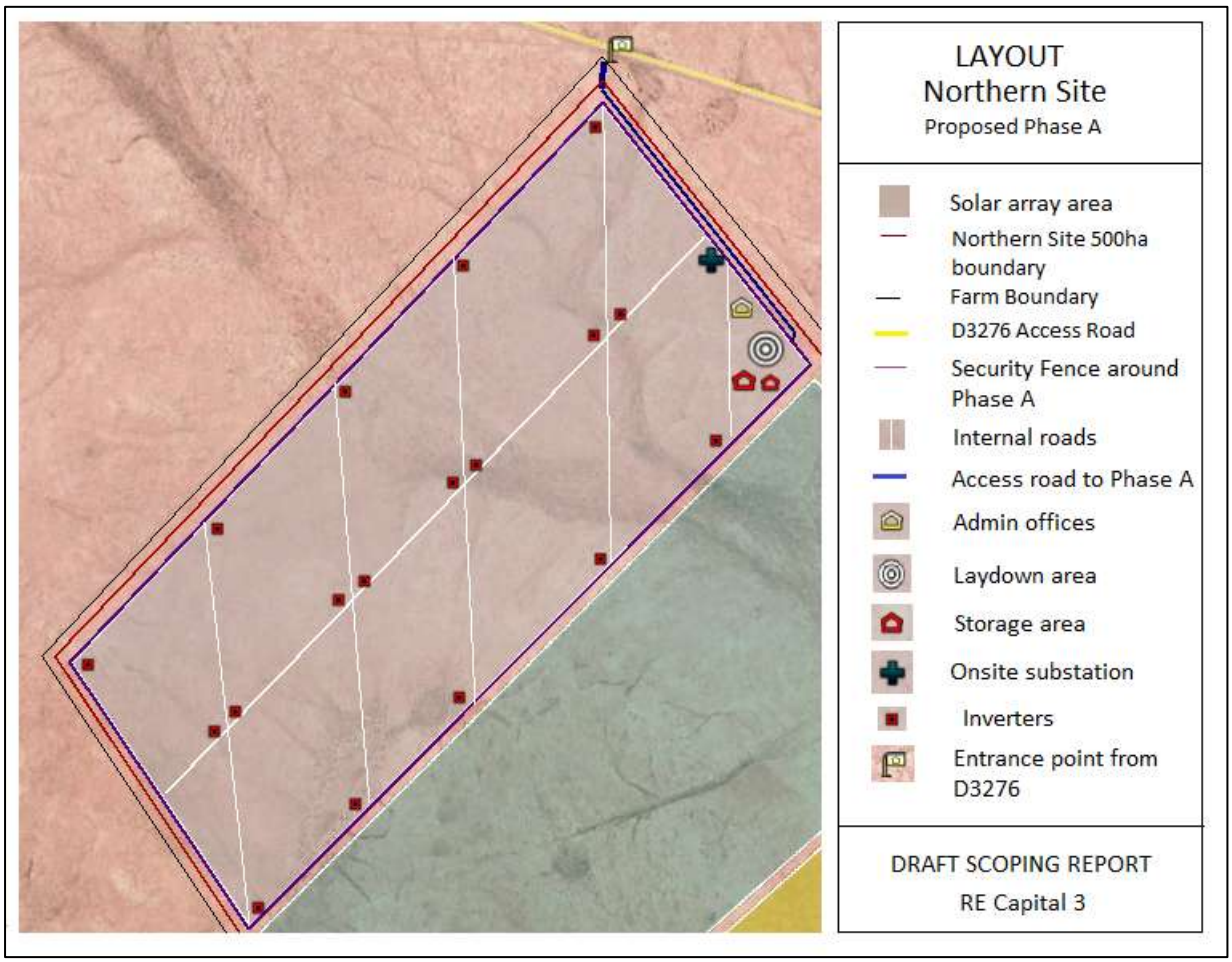

Figure 5: Northern site, phase A

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, these components include solar arrays, 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 165 hectare 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 array 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 systems output. Where a tracker system is used, each of the arrays is controlled individually and standardised systems are preferred

for economic and practical reasons. The standardised length would typically be between 50 and 200m long.

The solar arrays 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 solar frames will be installed using small concrete blocks, driven piers or a deep seated mounting screw. A ramming method would have the least impact on the environment. This method would also allow the frames to have a very small mounting footprint which would avoid any obstructions to natural water flow. As far as practically feasible the poles would be driven in as far as possible from all washes and according to the ecological constraints.

Figure 6: 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 effect on the environment would be similar for any of the selected processes. The figure below shows that 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 it would be trimmed to size. As far as practically possible these borders will be kept undisturbed.

Figure 7: Construction of PV plant (Image from www.aceinfra.com and www.kaska.eu)

Grid connection and cabling

The electrical feeding line is proposed to be constructed to the new planned Eskom MTS. Depending on the location of the new MTS, the power line alternative is investigated for different routes. This electrical line would run along the existing access road or border fence, to minimise the effect on the environment. This electrical line would be kept above ground and would feed into the new MTS with a 132kV line.

A 75MW 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 on the diagrams 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 considerations, meaning that suitable areas having a minimal impact on the environment would be preferred. Interconnecting cables may be trenched where practically possible but in areas of high sensitivity cables would be mounted to the structure avoiding excessive excavation works and clearing of vegetation. These inverter stations would typically be built into a transportable container measuring 10 x 2.5m, having a footprint of 25 square meters.

The preferred inverting stations would not make use of excessive air condition cooling and would house a dry solid transformer. This reduces the threat of environmental risks associated with oil cooled transformers. By using advanced cooling methods air condition noise could also be limited.

Auxiliary building area

The main storage, workshop, ablution and admin 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 (this has not yet been taken into account with the preliminary layouts). The final storage and admin areas would also be selected to minimise its 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 1kl 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 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 mitigated by applying appropriate building methods.

Preliminary layout for phases B and C

The general explanation of the layouts in the previous section give a bit more detail regarding the components indicated in the diagrams. The explanation is also applicable on the diagrams that follow in this and the next sections.

Below are the two preliminary diagrams for phase B and C. The layouts for phase B and C look more or less the same as phase A.

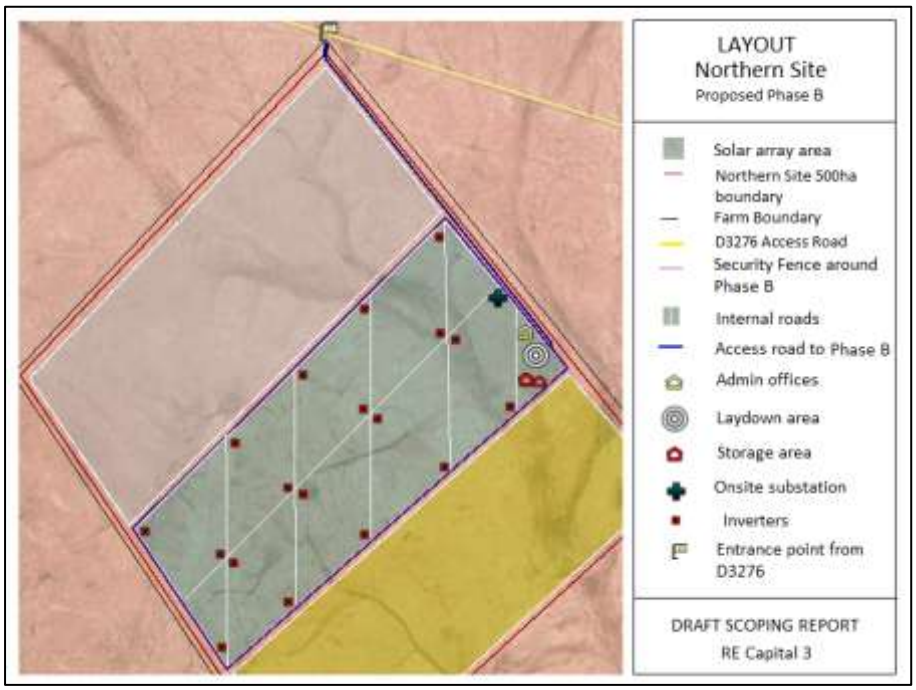

Figure 8: Northern site, phase B

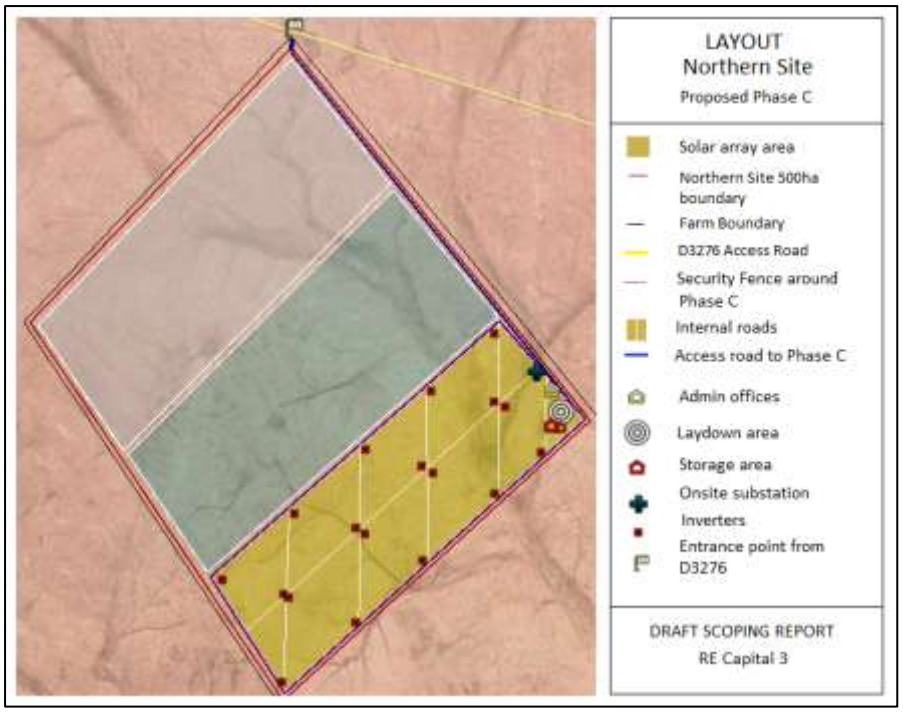

Figure 9: Northern site, phase C

The timelines of when each phase will be built is pending the REIPPP bidding results. Each of the phases will go into separate bidding rounds, and depending the outcome of the bidding round, will start construction a few months after the phase have been approved. The diagram below gives a illustration how the total plant will look (combining phase A, B and C).

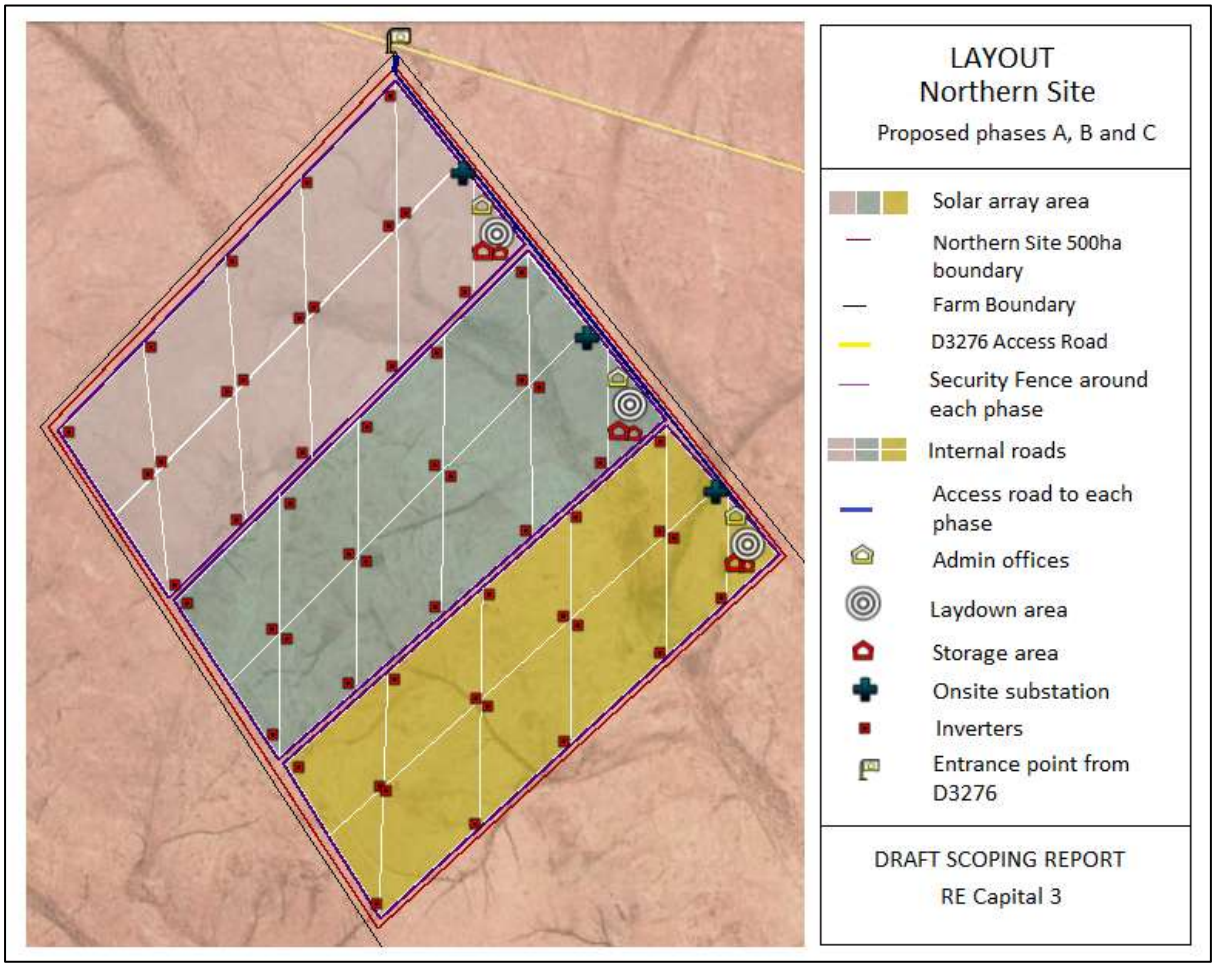

Figure 10: Northern site combined layout

Again, the diagram 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. The final positions of this infrastructure will be responsive to constraints identified by the Ecological Specialist and Archaeologist.

Power line alternatives

Four power line alternatives are investigated for the northern site. These alternative routes all lead from the individual on-site substations, to one of the three proposed locations for the new Eskom MTS substation. Option 1 will be across the neighbouring farm to the northern MTS possible location. Options 2 and 3 will also be across the neighbouring farms, to one of the two possible southern MTS locations. The fourth option is down the border of the Dyason's Klip farm to the existing 132kV line. The new power line will either loop into this existing 132kV line, or run parallel to the line, to the proposed MTS substation.

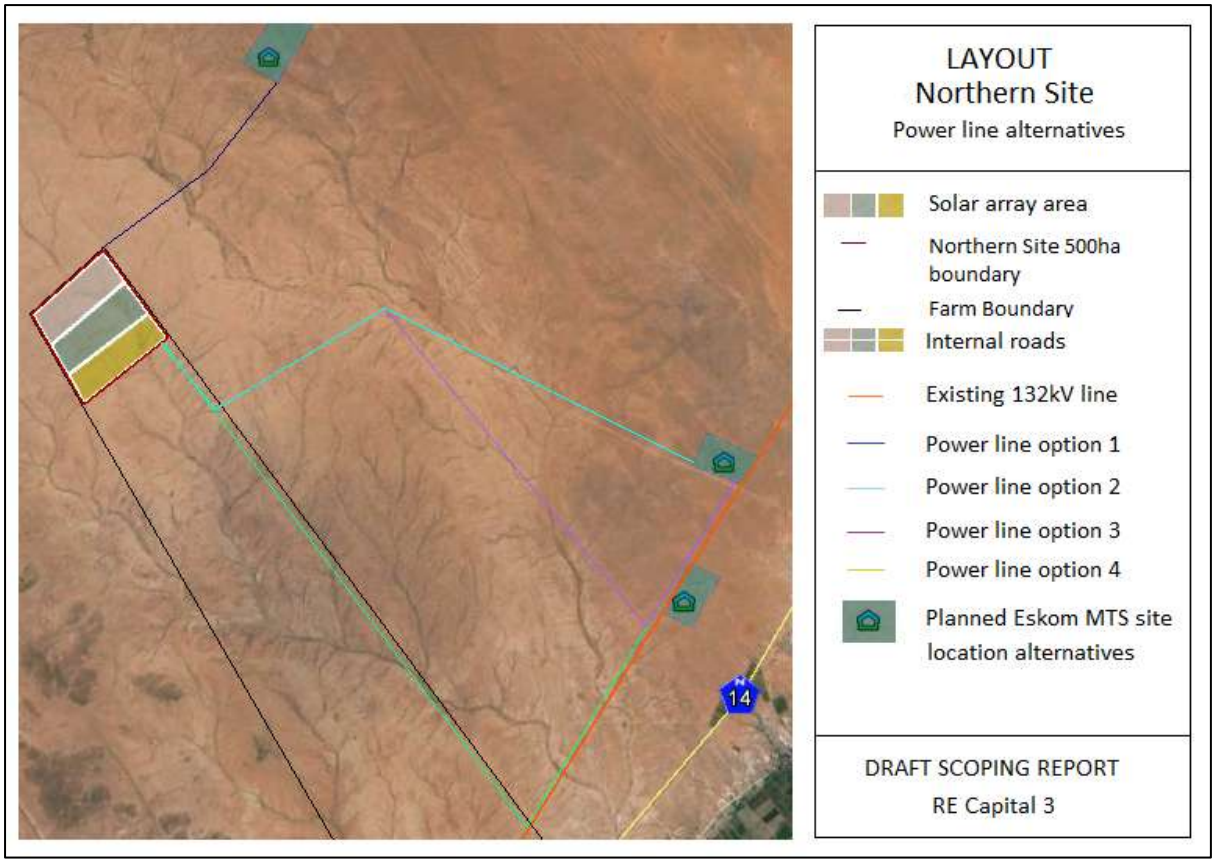

Figure 11: Northern site grid connection alternatives

Central Site

In this section the layout of the central site will be discussed in more detail. Please refer to the previous sections for the explanation of the different components of the layout.

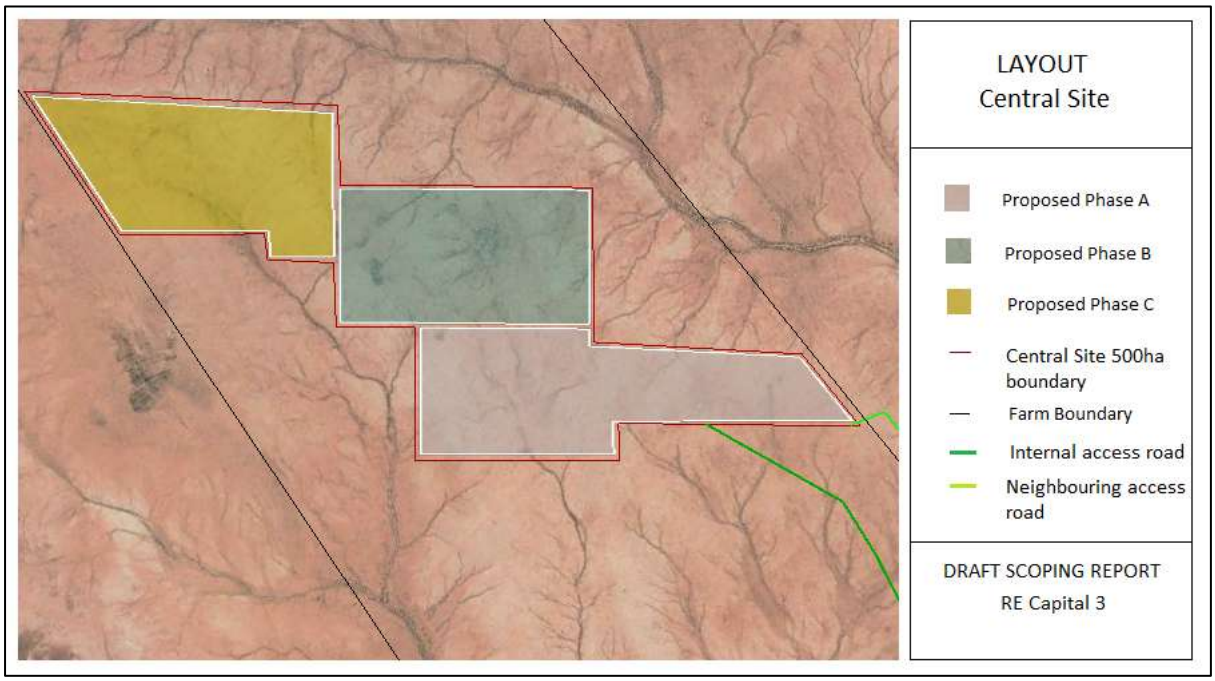

Figure 12: Central site phase layout

Again, the 500 hectare area was identified due to its level surface, relatively easy access, and the close proximity to the existing 132kV line and proposed new MTS substations.

Exactly the same as with the northern site, the identified 500 hectare study area has been divided into three parts, approximately 165ha each, on which the three phases will be developed. The optimum arrangement of the three phases has not been fixed, and will only be determined once the project has been awarded preferred bidder status. The arrangement above will be used as a typical layout. In terms of environmental impact, the typical layout should give an adequate indication of the different components that will be present on site.

Access to the site

Access to the central site can be via two alternative routes. There is an existing farm road running from the N14 to the proposed site. This is indicated on the map as the “internal access road”. This road will have to be upgraded and expanded to a width of approximately 6m, to make allowance for the construction vehicles. The second alternative is by using the access road of the neighbouring solar facilities “neighbouring access road”, which runs directly adjacent to the Dyason’s Klip farm. This road is being constructed by the neighbouring project teams, to serve as an access alternative to their projects. No additional alterations to the road should be necessary. Consent to co-use this road is being negotiated.

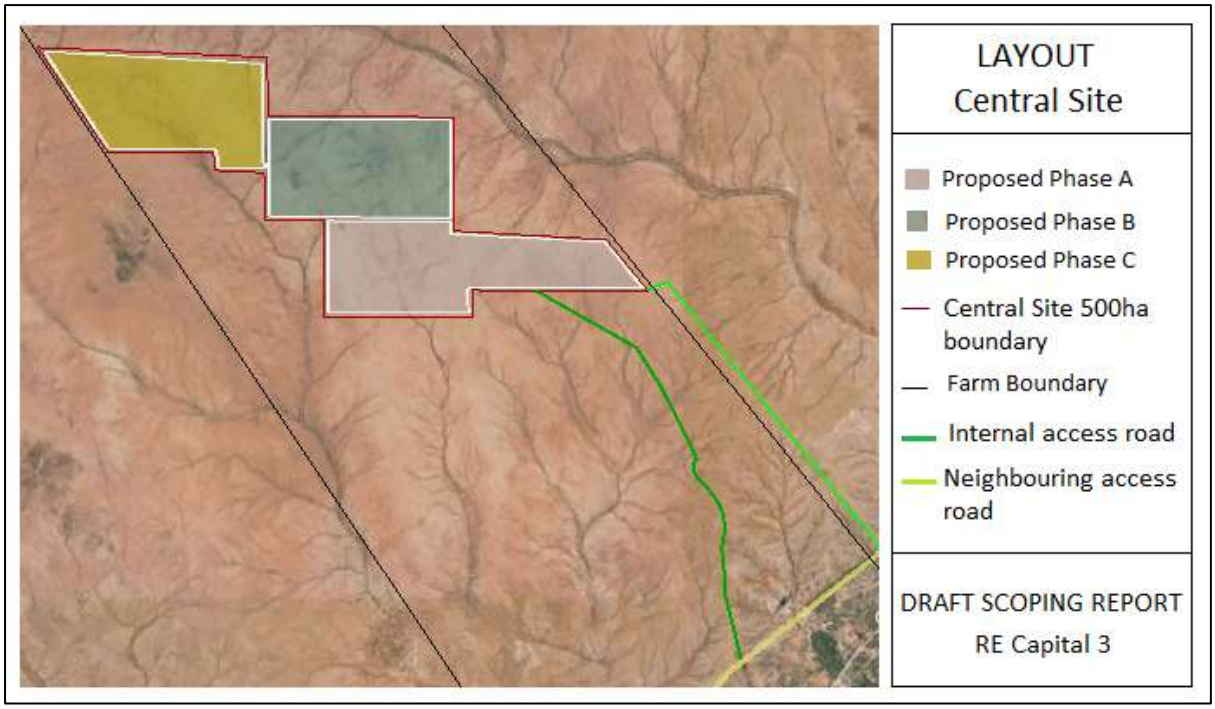

Figure 13: Central site access road alternatives

Preliminary Layout

The preliminary layout for the central site consists of the same components as the northern site. Below are the individual layouts of the three phases, as well as the combined layout illustration.

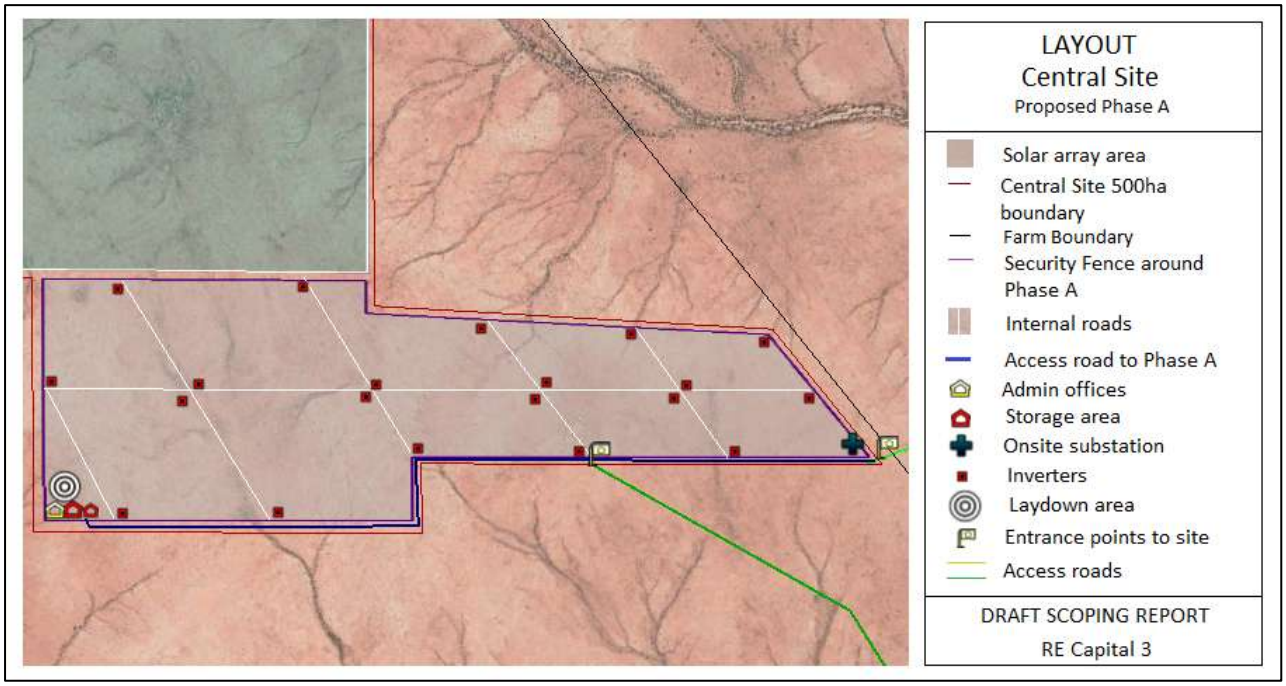

Figure 14: Central site, phase A

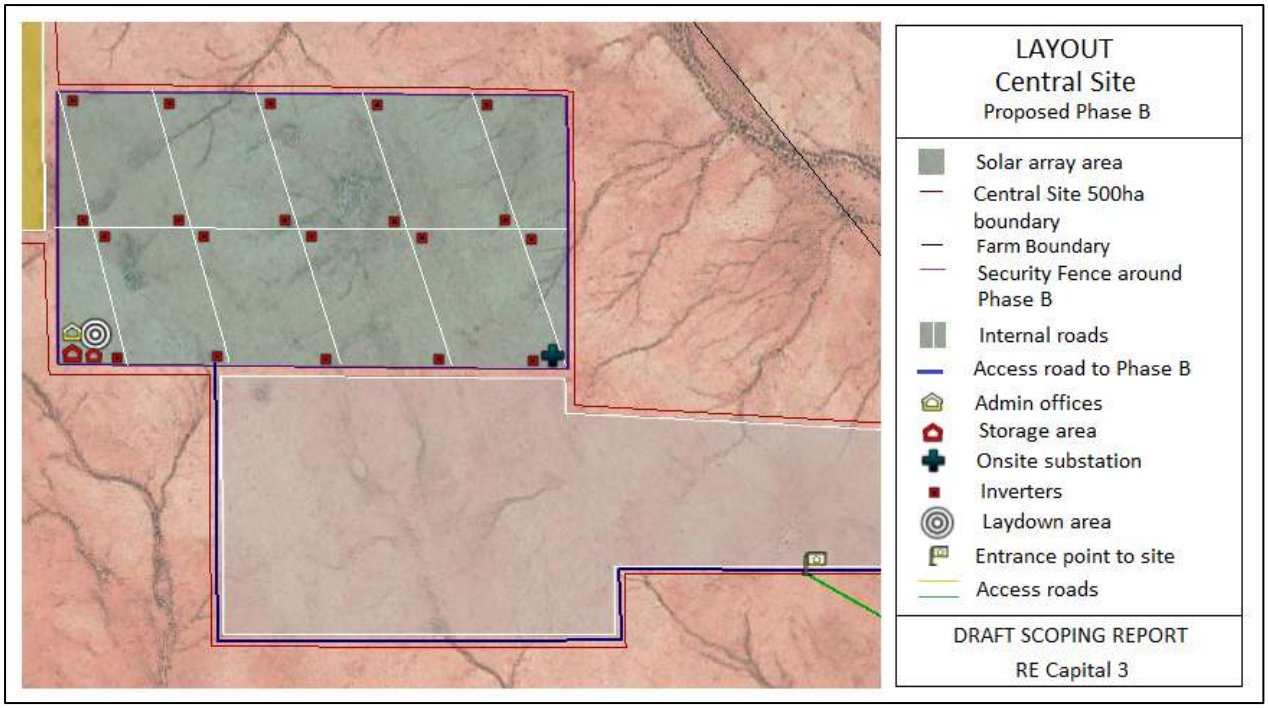

Figure 15: Central site, phase B

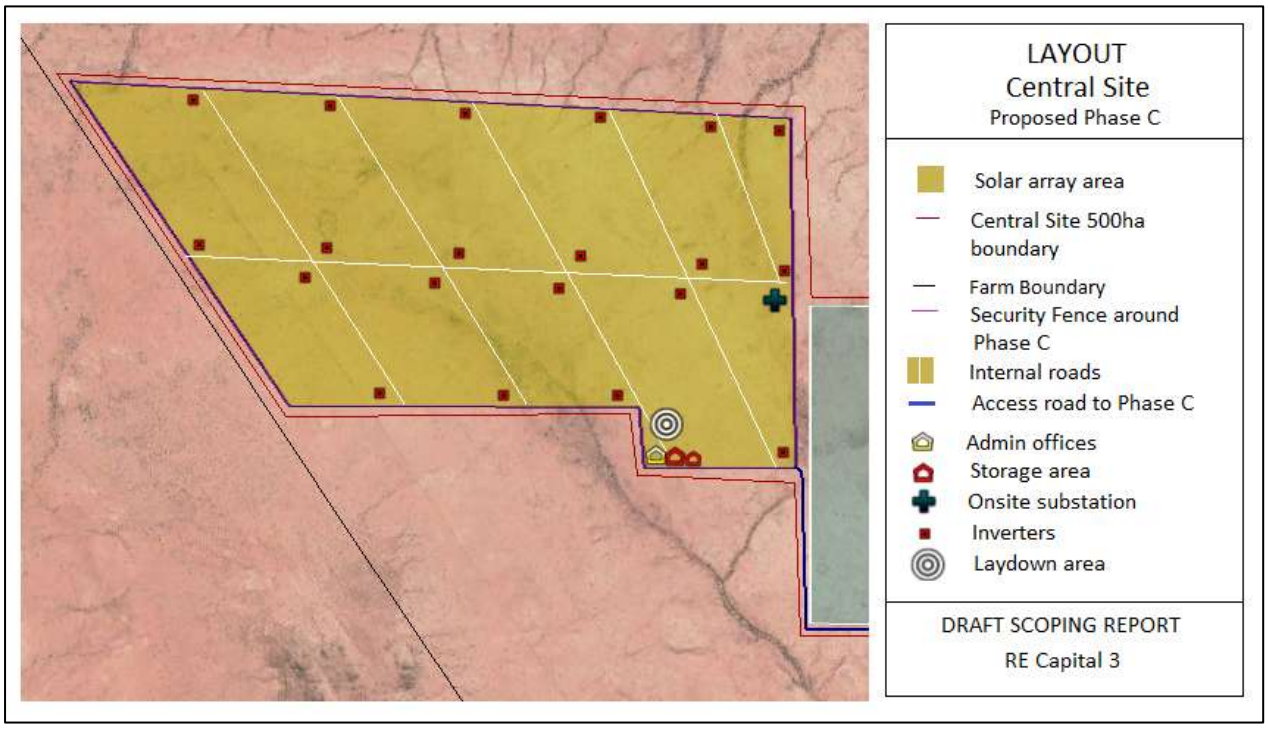

Figure 16: Central site, phase C

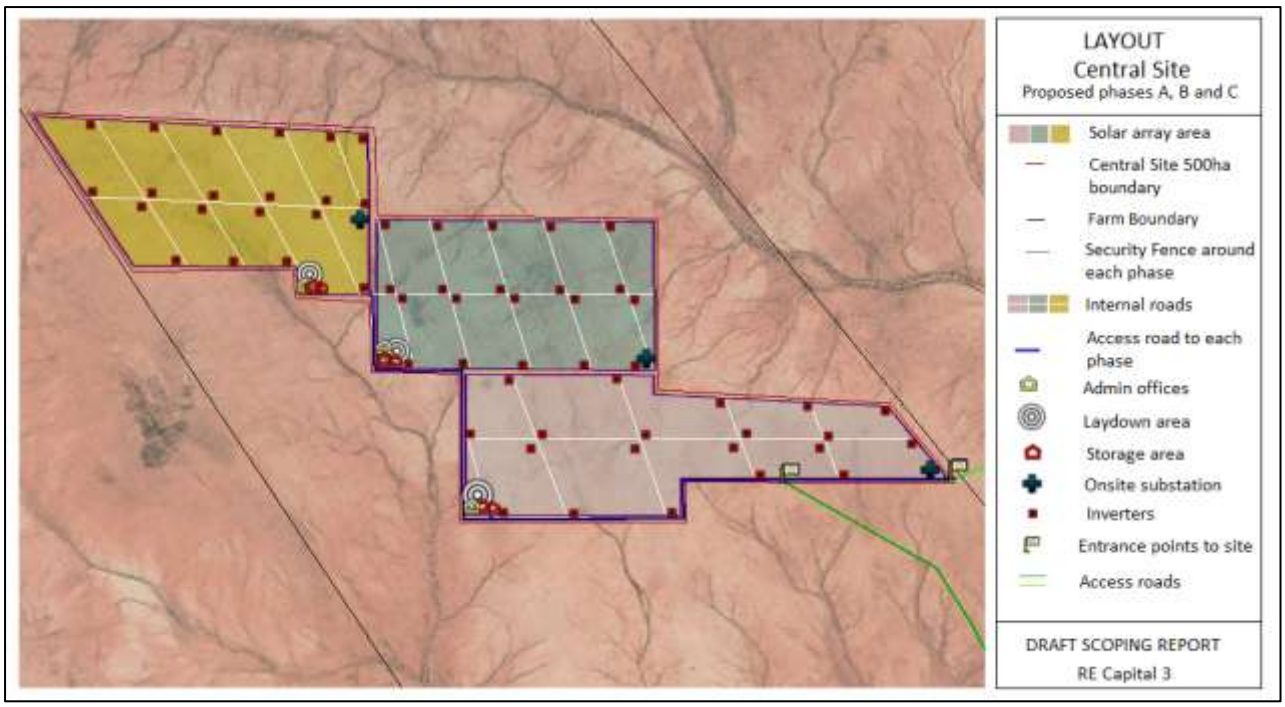

Figure 17: Central site combined layout

Power line alternatives

For the central site four additional power line alternatives are investigated. As with the Northern site, these alternative routes all lead from the individual on-site substations, to one of the proposed locations for the new Eskom MTS substation. Option 1 will be across the neighbouring farm, on the southern border of the farm, to one of the two possible Southern MTS locations. Options 2 and 3 will also be across the neighbouring farms, to the two possible southern MTS locations, running parallel and on both sides of the existing 132kV line. The fourth option is across the neighbouring farm, along the northern border of the farm, to one of the substations. As with the Northern site, the options to loop in-to the existing line will also be investigated, although not indicated on the diagram.

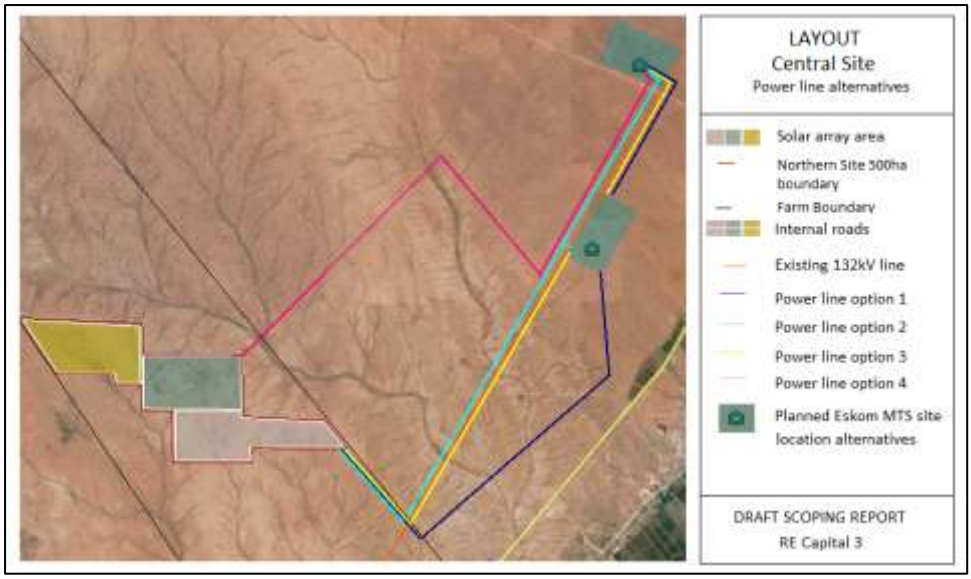

Figure 18: Central site grid connection alternatives

End comments

The layouts provided in this report will serve as the preliminary layouts for the environmental impact assessment. The comments and recommendations from the environmental specialists and all the interested parties will be taken into account when adjusting and re-designing these layouts. The updated layouts will be drafted and presented for comment in the next report.