4 PROJECT DESCRIPTION

4.1 INTRODUCTION

This Chapter provides an overview of the proposed Solar Power Farm at Humansrus. The need and desirability of the project and the consideration of alternatives is included here as well as a discussion of the main project activities for the construction, operation and decommissioning phases.

4.2 NEED AND DESIRABILITY

One of Intikon Energy's intentions in establishing a solar energy facility is to develop solar resources to generate electricity and reduce South Africa's dependence on non-renewable fossil fuel resources (see *Box 4.1*). According to Intikon Energy, the proposed Humansrus Solar Power Farm project would contribute to providing a future of increased energy security and sustainability whilst providing energy to facilitate South Africa's continuing development. Emergency load shedding in 2007 and 2008 highlighted the challenges facing South Africa in terms of electricity generation, transmission and distribution. The National Energy Response Plan (NERP), drafted at the time, acknowledged the role that independent power producers (IPPs) could play in ensuring sustainable electricity generation.

Box 4.1 Project Motivation

- Reduce South Africa's dependence on fossil fuel resources
- Improve reliability and range of electrical services
- Meet demand for diversified energy sources
- Ensure the future of sustainable energy use
- Reduce CO_2 emissions and the nation's carbon footprint
- Contribute to targets for emission reduction as outlined in IRP 2010
- Promote environmental, social and economically sustainable development
- Contribute to reaching South Africa's goal of 10,000 GWh of renewable energy by 2013
- Contribute to meeting the NERP goal of 30 percent of all new energy from IPPs

Global dependence on fossil fuels as an energy source, rising fossil fuel prices and concern about the impacts of climate change has resulted in increasing international pressure on countries around the world to increase their share of energy production from renewable sources. Policies and/or targets for the promotion of renewable energy now exist in more than 85 countries around the world and solar power generation is one the fastest growing areas of the renewable energy industry with a 53 percent growth occurring in grid-connected PV solar capacity globally during 2009 [(1)].

(1) REN21 (2010)

In South Africa the government has developed a policy framework (the White Paper on Renewable Energy) and set a target of sourcing 10,000 GWh from renewable energy projects by 2013 [1]. This amounts to approximately 4 percent of South Africa's total estimated energy demand by 2013. South Africa's Integrated Resource Plan (IRP 2010) [2] also sets targets for the reduction of CO_2 emissions by 34 percent by 2020; a goal that the renewable energy sector plays a major role in achieving.

Through the Humansrus Solar Farm and other renewable energy projects, energy generation will begin to depart from being dominated by coal. The electricity generated by this facility will supply the national grid and positively contribute to the country's goal of emission reduction as outlined in South Africa's Integrated Plan for Electricity 2010. The drafted policy notes the following objectives:

- Reduce CO_2 emissions by 34 percent by 2020 and 42 percent by 2025; and
- Apply an increase on the current carbon tax of R100/ton to roughly R750/ton of CO_2 over the next 30 years.

The carbon tax provides industries with incentives to utilise less carbon intensive practices which further increases South Africa's carbon footprint. Under the National Energy Regulator Act, 2004 (Act No 40 of 2004), the Electricity Regulation Act, 2006 (Act No 4 of 2006) includes a tariff that provides the renewable energy sector a competitive gain over current energy production. The motivating principles behind the Renewable Energy Feed-In Tariff (REFIT) include the following:

- Create an enabling environment for renewable electricity power generation in South Africa;
- Establish a guaranteed price for electricity generated from renewables for a fixed period of time that provides a stable income stream and an adequate return on investment;
- Create a dynamic mechanism that reflects market, economic and political developments;
- Provide access to the grid and an obligation to purchase power generated;
- Establish an equal playing field with conventional electricity generation; and
- Create a critical mass of renewable energy investment and support the establishment of a self-sustaining market.

The Electricity Regulation Act provides the National Energy Regulator of South Africa (NERSA) authorisation to determine the guidelines of REFIT. The guidelines provide parameters and information on:

- The requirements of the Independent Power Purchaser for the application;
- The issuing of licenses for renewable energy project developments; and

(1) National Energy Regulator of South Africa **South Africa Renewable Energy Feed-In Tariff** (2009) NERSA Publications.
(2)Department of Energy Integrated Resource Plan (2010)

- Tariff structures regarding varying renewable technologies.

The office of Renewable Energy Purchasing Agency (REPA) through the nation's leading public energy provider, Eskom is expected to be the interim single buyer of renewable power until an Independent System and Market Operator is established. If the IPP meets all of the required conditions of licensing, REPA then has an obligation towards the purchase of renewable sources of electricity. However, the IPP can also sell power directly to buyers outside of the REFIT programme, but will still be subject to the same licensing conditions.

Through REFIT there will be a heightened demand throughout the renewable sector (hydro, solar, wind, biomass) due to the set prices for electricity. The price of electricity from wind power under REFIT is listed below in *Table 4.1*.

Table 4.1 ***Feed-In Tariff for Wind and Solar Power***

Technology	**Unit**	**REFIT**
Wind	R/kWh	1.25
Solar PV (≥ 1 MW)	R/kWh	3.94

The economic rationale backing REFIT is that the establishment of the tariff will cover the cost of electricity generation in addition to producing a small profit to encourage developers to continue investing in the renewable sector (1).

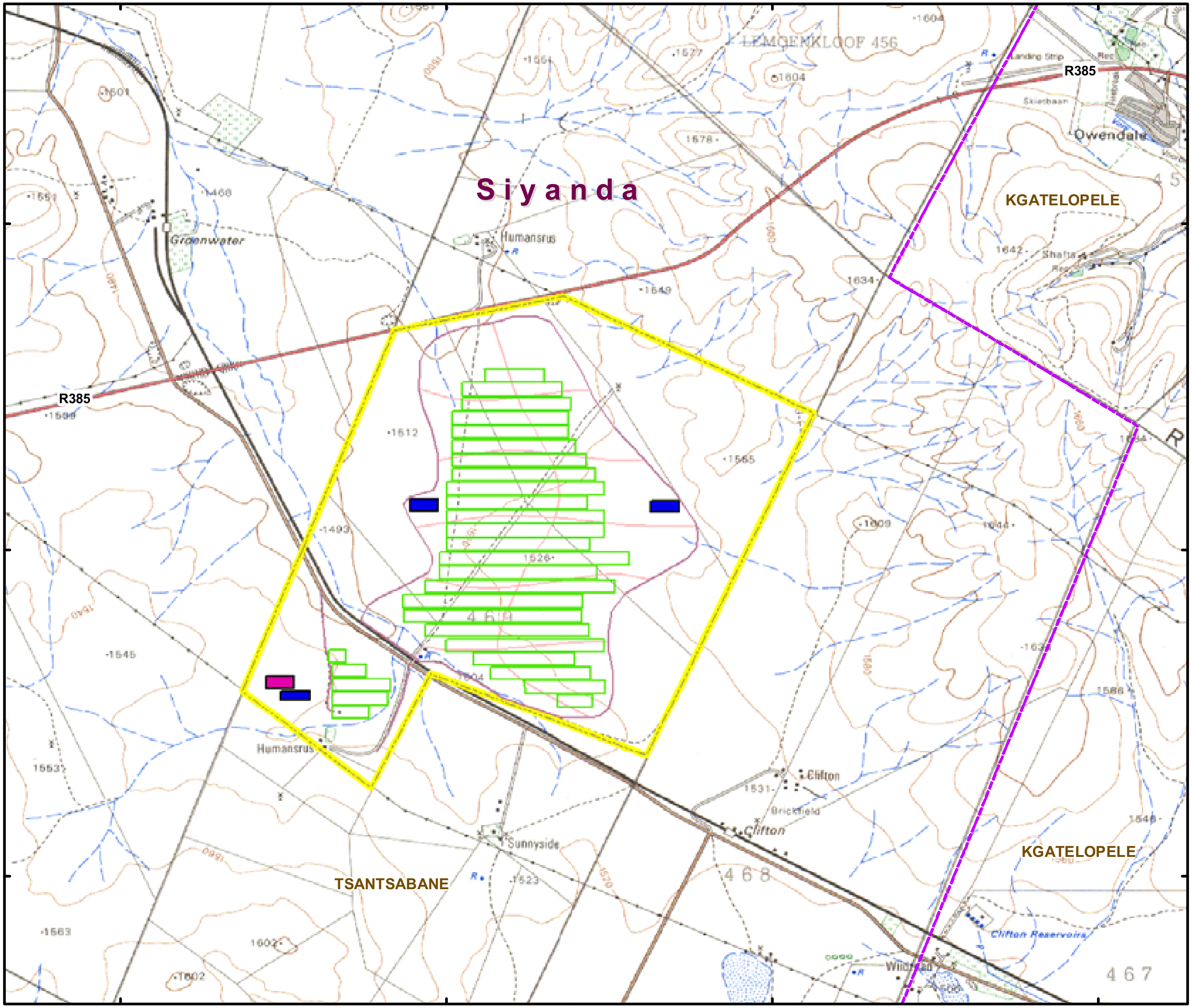
In addition to the energy produced by the solar power facility, the proposed project has the added advantage of income generation through the lease of land, which can supplement the income of marginally productive farms. Income generated by the facility could also potentially be used to fund community development projects.

4.3 *SITE LOCATION*

The proposed solar power farm is located near the settlement of Groenwater in the Northern Cape Province. The site is located on part of Humansrus Farm (Farm 469), approximately 4 km southeast of Groenwater and 30 km east of Postmasburg. The approximate site boundary is shown in *Figure 1.1* and the site location is shown in *Figure 4.1* below. The site area as depicted in *Figure 4.1* is approximately 2233 ha, with the infrastructure on site taking up a maximum of 450 ha (approximately 20 percent of Farm 469).

Note that the site boundary has been altered slightly since the distribution of the Draft Scoping Report to include a small piece of land to the west of the railway lines in the southwest of the site (this land is also part of Farm 469).

(1) National Energy Regulator of South Africa **South Africa Renewable Energy Feed-In Tariff** (2009) NERSA Publications.



Legend

- Humansrus Study Boundary
- Local Municipalities
- Transmission Line
- Main Roads
- Secondary Roads
- Other Roads
- Railway
- Rivers
- Contour Lines
- Cultivated Areas
- Pan
- Operations Maintenance/Facility
- Substation
- Gravel Perimeter Road and Security
- Secondary Gravel Service Roads
- Solar Panel Arrays

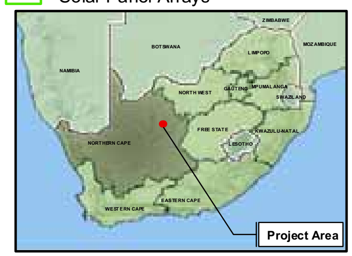


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Figure 4.1: Humansrus Solar PV Solar Power Topographical Map showing Project Infrastucture and preferred Alternative 2

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DATE: May 2011	CHECKED: CA	Project: 0112812
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Projection: Geographic, Datum: WGS84
Source: Chief Directorate: National Geo-Spatial Information
Map Number: 2823AD
SIZE: A4

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4.4 *PROJECT COMPONENTS*

It is anticipated that, once operational, the facility will generate up to 160 MW of electricity which will be fed into the national power grid. The key components of the proposed solar power farm include the following, which are discussed in more detail below:

- PV arrays
- Electrical connections
- Substation
- Access roads and site access

4.4.1 *PV Arrays*

The development will include PV solar panels that will occupy up to 350 ha (3.5 km^2) of the site area in total. The panels will be situated in rows extending across the site in lines. The collective term for a series of PV panels in rows is a PV array. PV panels are typically up to 15 m^2 in size and the rows will be approximately 1 km in length, made up of approximately 100 m sections depending on the final design and layout of the development. The panels will be mounted on metal frames with a maximum height of approximately 3 m above the ground, supported by concrete or screw pile foundations, and they will face north in order to capture the maximum sunlight. The facility will either be a fixed PV plant where the solar panels are stationary; or a tracking PV plant where the solar panels rotate to track the sun's movement (the exact type of PV plant system will be determined following on-site solar resource modelling and detailed development design). *Figure 4.2* shows a typical array of PV panels.

Figure 4.2 Typical PV Array

4.4.2 Electrical Connections

The rows of PV panels will be connected to an internal electrical collection system, which is likely to be a single transmission line slung overhead between each array. An inverter will connect to each row of PV panels to convert the direct current (DC) output to alternating current (AC). The inverters will connect to a number of step-up transformers, which will convert the low voltage AC to a medium voltage suitable for the internal collection system (probably 11 or 22 kV). A medium voltage collection system will then transport the electricity to a substation which will connect the facility to the national grid via an existing 132 kV overhead transmission line which passes though the west of the site. The medium voltage collection system will be comprised primarily of underground cable, but may include some minor stretches of overhead connection lines if the distance or terrain dictates. The extension of the solar farm across the railway line and dirt service road will be made by using one of three culverts underneath the railway line.

4.4.3 Substation and Grid Connection

A new substation would be built as part of the development to facilitate connection of the solar power farm to the national grid network via the existing transmission facilities as outlined above. The high voltage side of the substation would be built, maintained and owned by Eskom. The substation would be located close to the existing transmission line in the west of the site. The substation would incorporate an area of up to 1,000 m^2 in size; would include a control room, operations and maintenance facility, parking, external

132 kV transformers, electrical switchgear and would be fenced for security and safety. A typical substation is shown in *Figure 4.3* below.

Figure 4.3 Typical Substation

4.4.4 Access Roads and Site Access

The site will be accessed via the R385 or D3381. Within the site area existing farm tracks will be up-graded and new gravel roads may be constructed to facilitate movement of construction and maintenance vehicles. There will be an access track adjacent to each row of the PV array plus tracks between the other components of the development. Site access roads that are developed will be up to 6 m wide with drainage trenches adjacent to the road. There is an existing railway line located in the southern section of the site, Intikon intend to enter into discussions with the relevant parties to potentially use this railway line to transport the PV panels to site.

4.4.5 Additional Infrastructure

Additional infrastructure that will be required for the project includes the following:

- A permanent solar irradiation measuring panel (approximately 16 m^2 in size) will be erected to collect data on the solar resource at the site [(1)].
- A small office and storage building with security and ablution facilities.
- Site fencing.
- A lay-down area for the temporary storage of materials during the construction activities.

(1) Note that this measuring panel will be erected during the feasibility stage, prior to the start of project construction and does not form part of the EIA.

There are two borrow pits within 2 km of the site, however an additional small borrow pit (subject to the appropriate permits) may be developed within the site area. The size of this pit would depend on the terrain, suitability of the subsurface soils and the requirement for granular material for access road construction and other earthworks; this can only be ascertained once geotechnical studies have been undertaken on site. Should a borrow pit be required this would not be located within any of the buffer areas indicated by the specialists and depicted in *Figure 4.5* below and would be rehabilitated at the end of construction using surplus material excavated from foundations or other site excavations.

Existing boreholes (subject to the appropriate permissions and current abstraction limits) will be used for the water required for ablution facilities and a minimal amount for periodic cleaning of the solar panels during operations. Additional water may be required for cleaning once or twice per year, should this be the case, it would be brought in by truck in order to minimise use of borehole water.

The site has been chosen based on a number of technical, financial, environmental and social criteria but the detailed design of the development has not yet been concluded. The final design of the facility including the overall size and layout of the PV array, and the location of other project components will be determined using information gathered from the solar irradiation measuring panel, the information gathered during the specialist studies phase and environmental and social considerations described in the EIA.

4.5 PROJECT ACTIVITIES

The project life-cycle can be divided into three phases. These phases are outlined in the sections below.

4.5.1 Site Preparation and Construction

Prior to construction of the solar power farm, the site would be prepared. This would include the following activities:

- vegetation clearance;
- levelling and grading of areas where the array will be sited to remove steep slopes and undulations;
- levelling of temporary hard-standing areas;
- erection of site fencing; and
- construction/upgrading of on-site access roads.

Once the site has been prepared, prior to the installation of the PV components, the following construction activities would take place:

- construction of site office and storage facilities;
- laying of PV panel, inverter and step-up transformer foundations;
- installation of low and medium voltage cables; and
- substation construction.

The PV components will be imported to South Africa and delivered to site in small trucks. Once the PV components have arrived on site, technicians will supervise and complete the assembly and test the facility.

During the construction period only limited numbers of local people will be directly employed by the project; namely for site security, manual labour, transportation of goods and other similar services. The PV component assembly and testing will be undertaken by a highly-skilled team of solar energy technicians (the majority of which would likely be from overseas as a workforce of this type is not currently available in the South African market but does provide the opportunity for capacity building).

It is envisaged that the development will be constructed in a phased approach. During each phase of the development solar modules capable of producing approximately 30 MW of power will be developed. The exact size of each phase may be dependant on the MW allowance of the IPP licence that is granted by NERSA, therefore, the modular approach has not yet been designed in detail but a single 30 MW module would take approximately 5 months to install from site preparation to commissioning. The substation and associated infrastructure may take up to 8 months to build. Installation of the full 160 MW would take up to 4 years, allowing for breaks between the construction of different phases to fit with successive rounds of IPP licensing by the government.

4.5.2 Operation

Once each phase of the facility is complete and operational it is expected that the facility would have a lifespan of around 25 years. Regular maintenance would be required to keep the PV cells in optimal working order. Most day to day facility operations would be done remotely through the use of computer networks but some limited maintenance, such as cleaning of the solar panels and repair activities, would be undertaken on site.

During the operations phase the PV facility would be able to operate in conjunction with some activities such as grazing of small livestock (eg sheep), however, the facility could not operate in conjunction with cultivation activities as the vegetation below the array needs to be kept to a minimum to reduce the risk of fire at the site.

4.5.3 Decommissioning

It is anticipated that the facility would be operational for approximately 25 years. Once the facility reached the end of its life the solar panels could be refurbished or replaced to continue operating as a power generating facility, or the facility could be closed and decommissioned. If decommissioned, all the components of the solar power farm would be removed and the site would be rehabilitated. The concrete foundations of the PV array would be removed to below ground level and would be covered with topsoil and be replanted to allow a return to agricultural land use (cultivation and grazing). Some access roads may be also be removed and rehabilitated should they not be required by the landowner.

4.6 *CONSIDERATION OF ALTERNATIVES*

4.6.1 *Site Location Alternatives*

As part of the site selection process Intikon Energy undertook an integrated site selection study in order to identify suitable sites for the development of solar power facilities. During the site selection process 10 potential sites in the Northern Cape and Free State Provinces were investigated during a desk-top and remote sensing exercise. Of these 10 sites, six were further investigated during a ground-truthing exercise. The proposed solar energy site on Humansrus farm is considered highly desirable due to the following considerations.

- Solar resource: Analysis of available data from existing weather stations suggests that the site has sufficient solar resource to make a solar energy facility viable.

- Site extent: Sufficient land was secured under long-term lease agreements with the land owner to enable sufficient power supply and to allow for a minimum number of PV panels to make the project feasible.

- Grid access: Access to the grid and adequate transmission lines were key considerations for site location.

- Strengthening the national grid: Selection of the sites was also cognisant of the need to strengthen the national grid by identifying sites that would help address transmission losses and boost supply in key areas. This was achieved through detailed discussion with Eskom.

- Land suitability: Sites that facilitate easy construction conditions (relatively flat land with few rock outcrops or waterbodies) were favoured during site selection.

- Landowner support: The selection of sites where the land owners are supportive of the development of renewable energy is essential for ensuring the success of the project.

Consideration of the above criteria resulted in the selection of the preferred site. No further site location alternatives have been considered in the EIA process.

4.6.2 *Site Layout Alternatives*

The PV array layout and project component design may undergo a number of iterations based on technical aspects of the project such as detailed site specific solar data and construction conditions, and the environmental and social considerations from the EIA process.

From a technical perspective, the PV array size and layout depends on a number of factors including:

- local topographical conditions and the aspect of the site in relation to the sun's daily movements;
- geotechnical characteristics of the site;
- the intensity of the solar resource at the site as determined from on site measurements and data modelling;
- other local meteorological conditions such the amount of suspended particles in the air (dust); and
- the characteristics of the specific PV panel model that is selected for the development, including the size and internal composition.

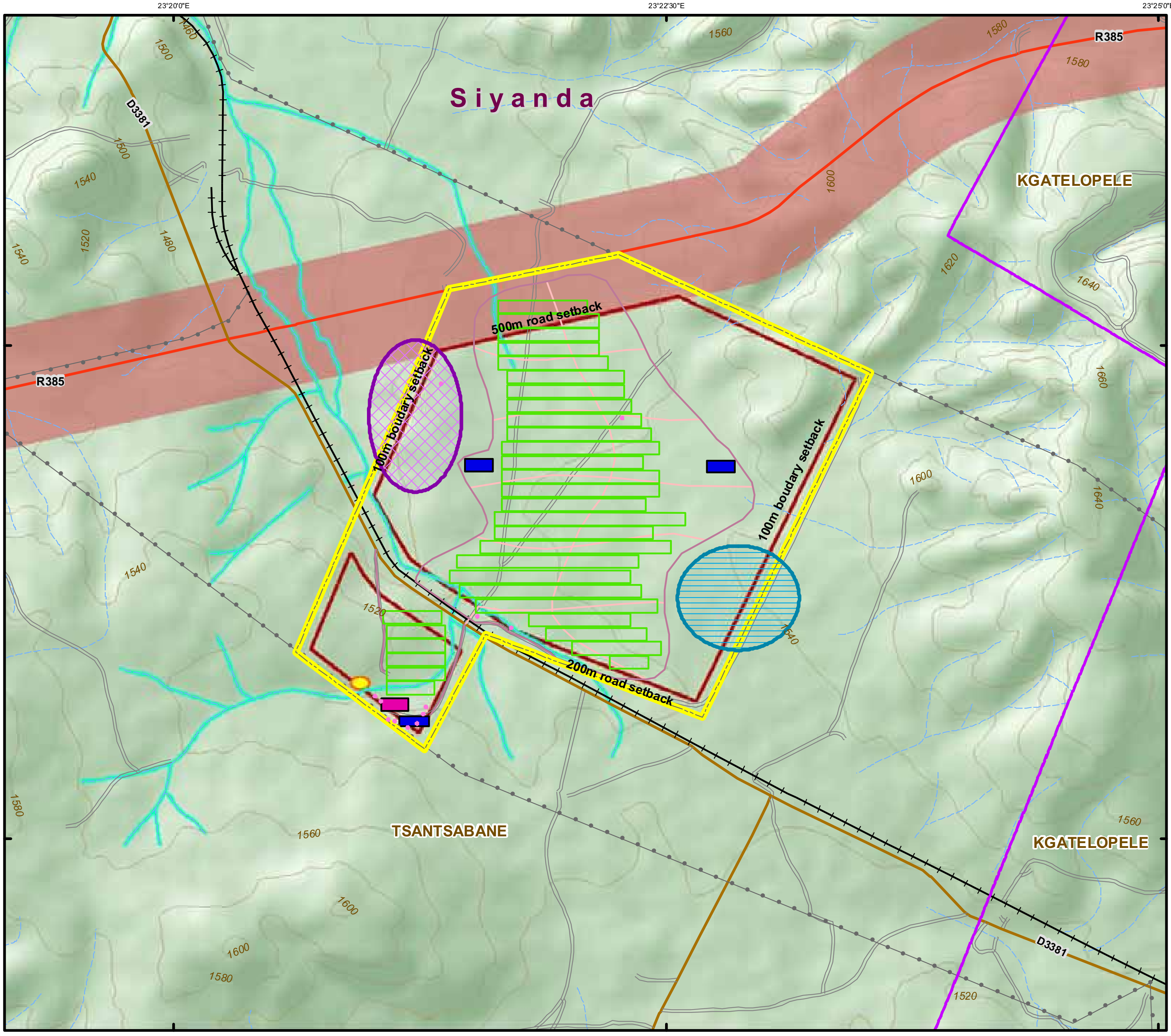
An indicative project layout has been developed using the resource data that is currently available. After initial field surveys by the EIA team, particular areas posing environmental and social constraints have been identified and fed back to the technical team in the form of a constraints map. A revised development layout taking these environmental and social constraints into consideration has been developed as the preferred alternative.

The above considerations and some technical and environmental exclusion zones, namely:

- 15 m buffer on either side of the non-perennial water course to the south of the site;
- 20 m buffer around heritage sites;
- 250 m visual buffer for the PV arrays, substation and maintenance building from local and secondary roads; and
- 100 m visual buffer from external farm boundaries.

The Intikon Energy technical team generated an indicative site layout design, Site Layout Alternative 1 (see *Figure 4.4*) for the project using the limited resource data available at the time.

After field surveys by the EIA team particular areas posing additional environmental and social constraints or specific unsuitable PV locations were identified and fed back to the technical team. Areas considered unsuitable were excluded based on potential impacts to vegetation, water courses and visual considerations. The technical team then generated a revised 'buildable areas map' and from there developed a revised turbine layout design, Site Layout Alternative 2 (see *Figure 4.5*) taking these environmental and social constraints into consideration. This process has encompassed the consideration of layout alternatives in the EIA process and Site Layout Alternative 2 is the preferred alternative.



Legend

- Groenwater Study Boundary
- Local Municipalities
- Transmission Line
- Main Road
- Secondary Road
- Track/Footpath/Other Access
- Railway
- Non Perennial Rivers
- Contours (20m)
- Solar Panel Arrays
- Operations Maintenance/Facility Options
- Substation
- Visual Setback Lines
- Secondary Gravel Service Roads
- Gravel Perimeter Road and Security
- 15m River Buffer
- 20m Heritage Sites Buffer
- Derelict Homestead and 3 Graves
- 200m Homestead & Graves Buffer
- 500m Road (R385) Buffer
- Jasper Hand Mining
- Olienhout Forest

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Figure 4.4: Humansrus Alternative 1 on the Constraints Map

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INTIKON ENERGY

DATE: Feb 2011	CHECKED: DA	PROJECT: 0112812
DRAWN: AB	APPROVED: SHC	Scale: 1: 50 000

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REV: 2

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ERM

Projection: Geographic, Datum: Wgs 84
Source: ACO (L Webley), Landscape Architect (B Oberholzer)
Inset: ESRI Data and Maps

SIZE: A3

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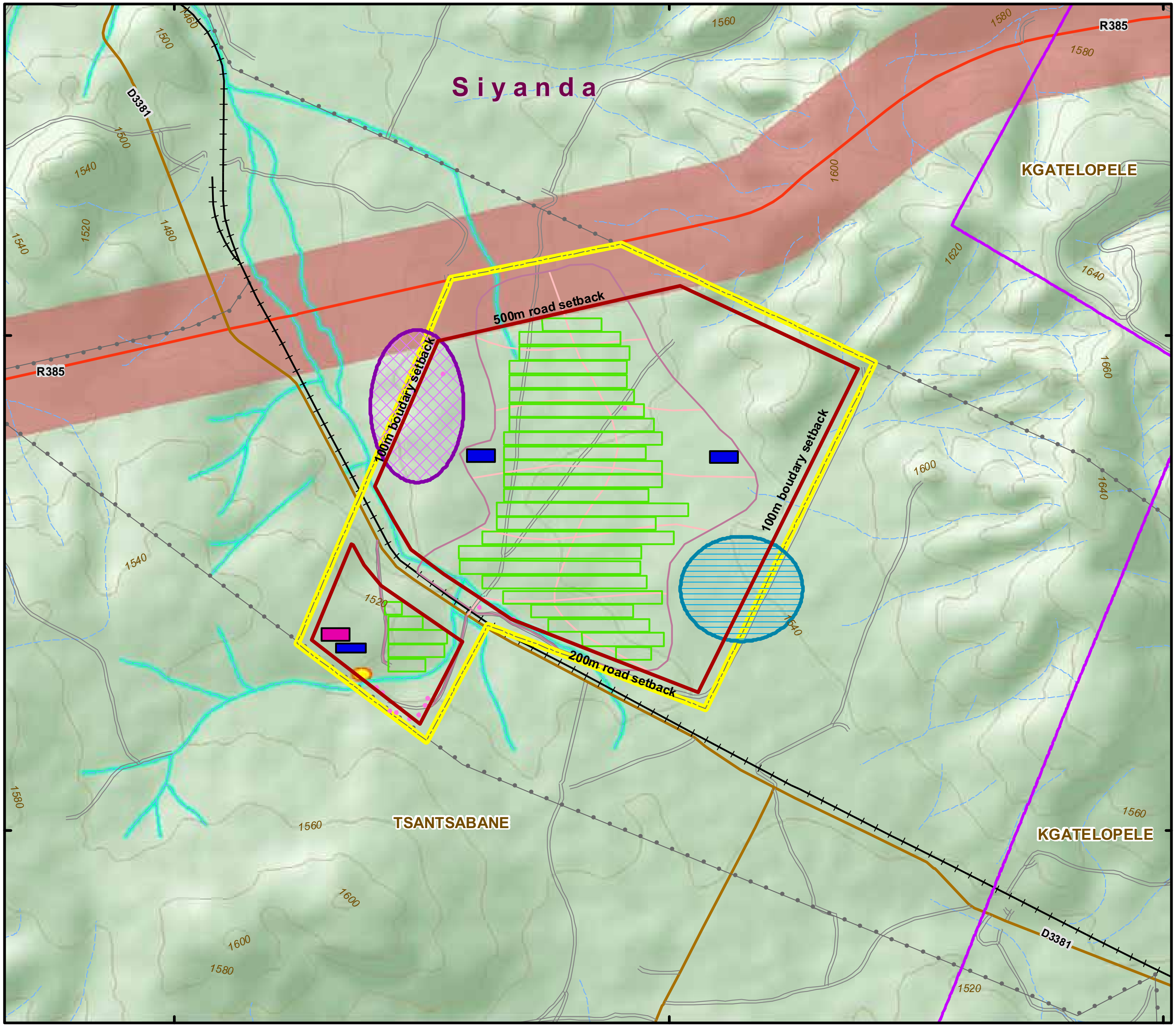

Legend

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- Derelict Homestead and 3 Graves
- 200m Homestead & Graves Buffer
- 500m Road (R385) Buffer
- Jasper Hand Mining
- Olienhout Forest

SCALE: 0 1 2 Kilometres N

TITLE:

Figure 4.5: Humansrus Alternative 2 on the Constraints Map

CLIENT: INTIKON ENERGY

DATE: May 2011	CHECKED: DA	PROJECT: 0112812
DRAWN: AB	APPROVED: SHC	Scale: 1: 50 000
DRAWING: 0112812_Humansrus_Constraints_Map_Alt2_Rev2.mxd		REV: 2

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Projection: Geographic, Datum: Wgs 84
Source: ACO (L Webley), Landscape Architect (B Oberholzer)
Inset: ESRI Data and Maps

SIZE: A3

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The aim of considering layout alternatives was to balance the technical and financial objectives of maximising the output of the proposed facility with the other critical environmental and social constraints including visual, botanical, fauna, and heritage.

It should be noted that the suitability of the indicative site layout design will be re-evaluated once sufficient solar resource data has been acquired at the site and further geotechnical work undertaken. Any revision of the design will be within the allowable zones prescribed by this EIR.

4.6.3 Grid Connection Alternatives

The options of the connection of the solar energy facility to Eskom's national grid are subject the on-going discussions between Intikon Energy and Eskom. The only connection option which is considered viable for the site is connection directly into the existing transmission facilities that traverse the site. The alternative grid connection scenario would involve an overhead transmission line to an alternative grid connection point which is not considered technically, financially or environmentally preferable given the availably of an existing grid connection option within the site area.

4.6.4 Technological Alternatives

Solar energy is considered to be an appropriate renewable energy technology for this site, based on the site location, ambient conditions and energy resource availability. There are a number of different solar energy technologies that include:

- fixed PV plants;
- tracking PV plants (with solar panels that rotate to follow the sun's movement);
- Concentrated Solar Power (CSP) plants; and
- concentrated PV Plants.

Financial, technical and environmental factors were taken into account when choosing the type of solar power technology for the site, including the local solar resource and its likely generation output, the economics of the proposed facility and availability of government feed-in tariffs and energy production licenses, and the requirement for other development inputs such as water resource requirements. The fixed PV or tracking PV technologies are considered to be the most technically and economically feasible. PV is also the most environmentally sensitive technology for the preferred site as no large volumes of water are needed for power generation purposes.

A number of different PV solar panel models are available with different dimensions and outputs. The preferred PV panel type has not yet been selected but different models suitable for installation will be considered with a range of outputs and sizes.

4.6.5 *No-go Alternatives*

The no-go alternative implies that the proposed project would not be executed. Assuming that the solar power facility would not be developed at the proposed site, there would be no increase in electricity generation from the facility, no CO2 offsets associated with the proposed development, no economic benefit to the landowners associated with the potential income generated through the operation of the facility and there would be no contribution to meeting South Africa's targets for renewable energy generation. Should the solar farm not be developed the agricultural potential of the site would not be lost due to the establishment of the facility on agricultural land. There would also be no negative environmental and social impacts associated with the development of a solar power facility.